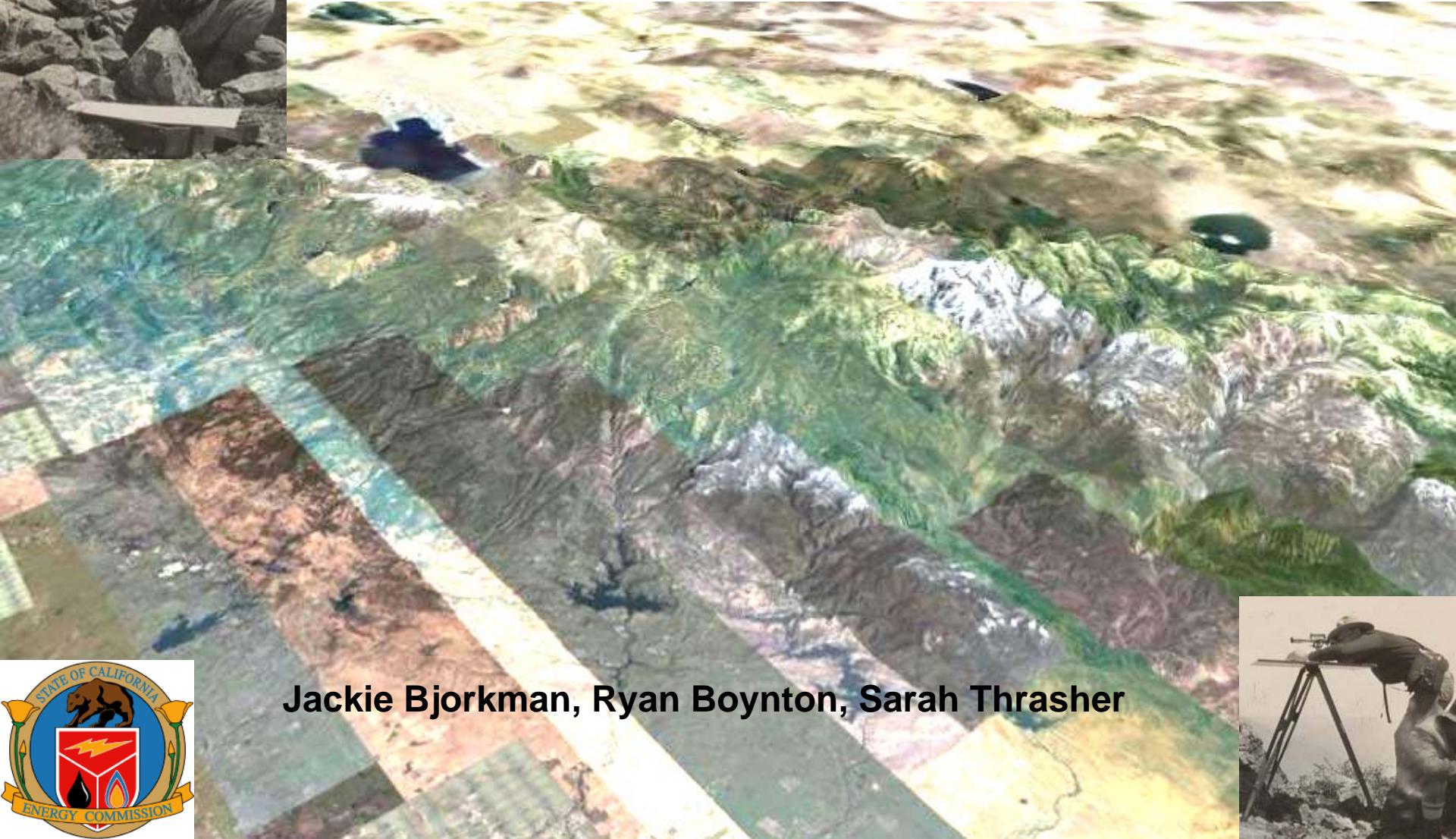




Observed Changes in Vegetation Patterns in California

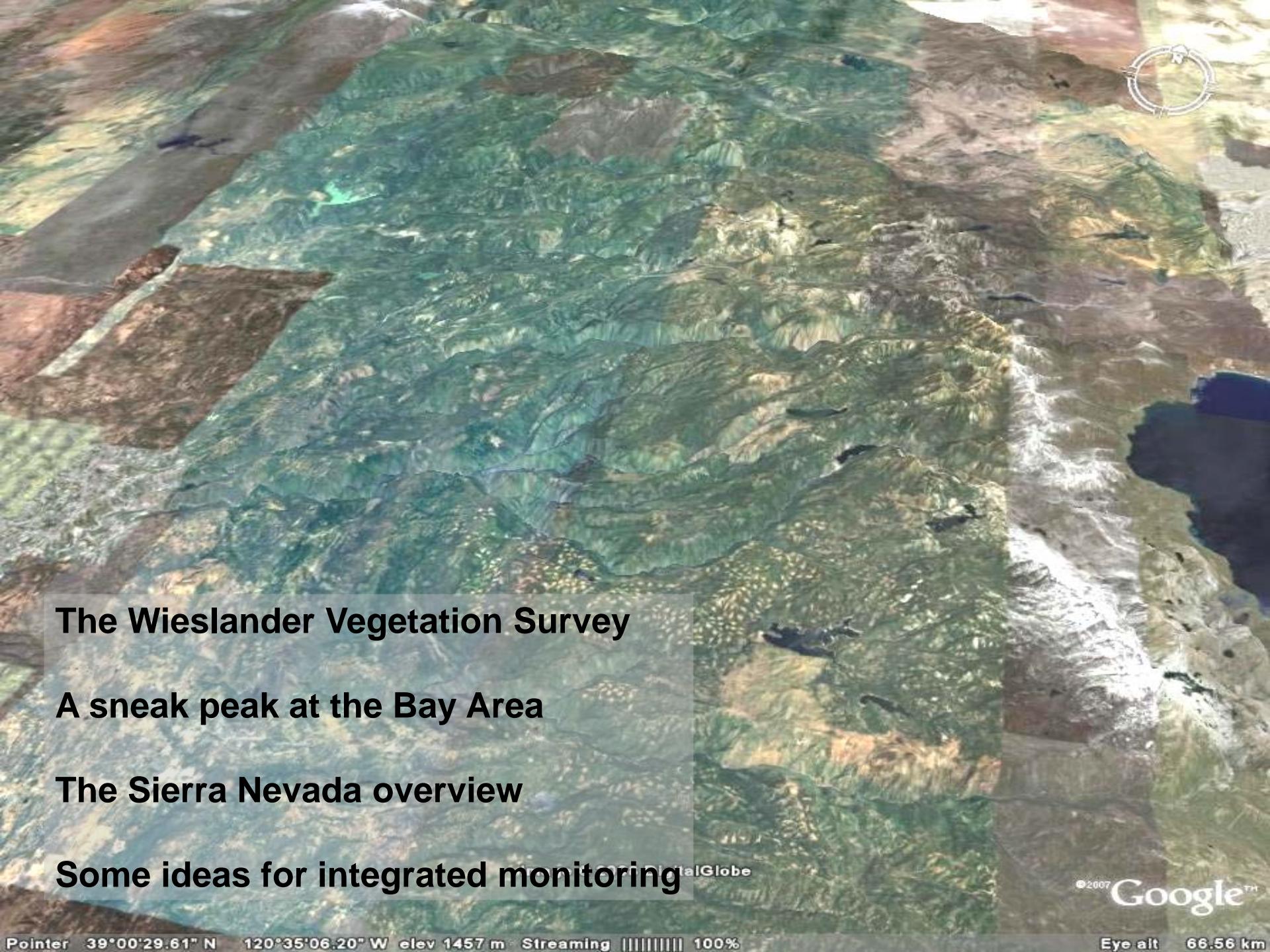
Jim Thorne

Information Center for the Environment, UC Davis



Jackie Bjorkman, Ryan Boynton, Sarah Thrasher





The Wieslander Vegetation Survey

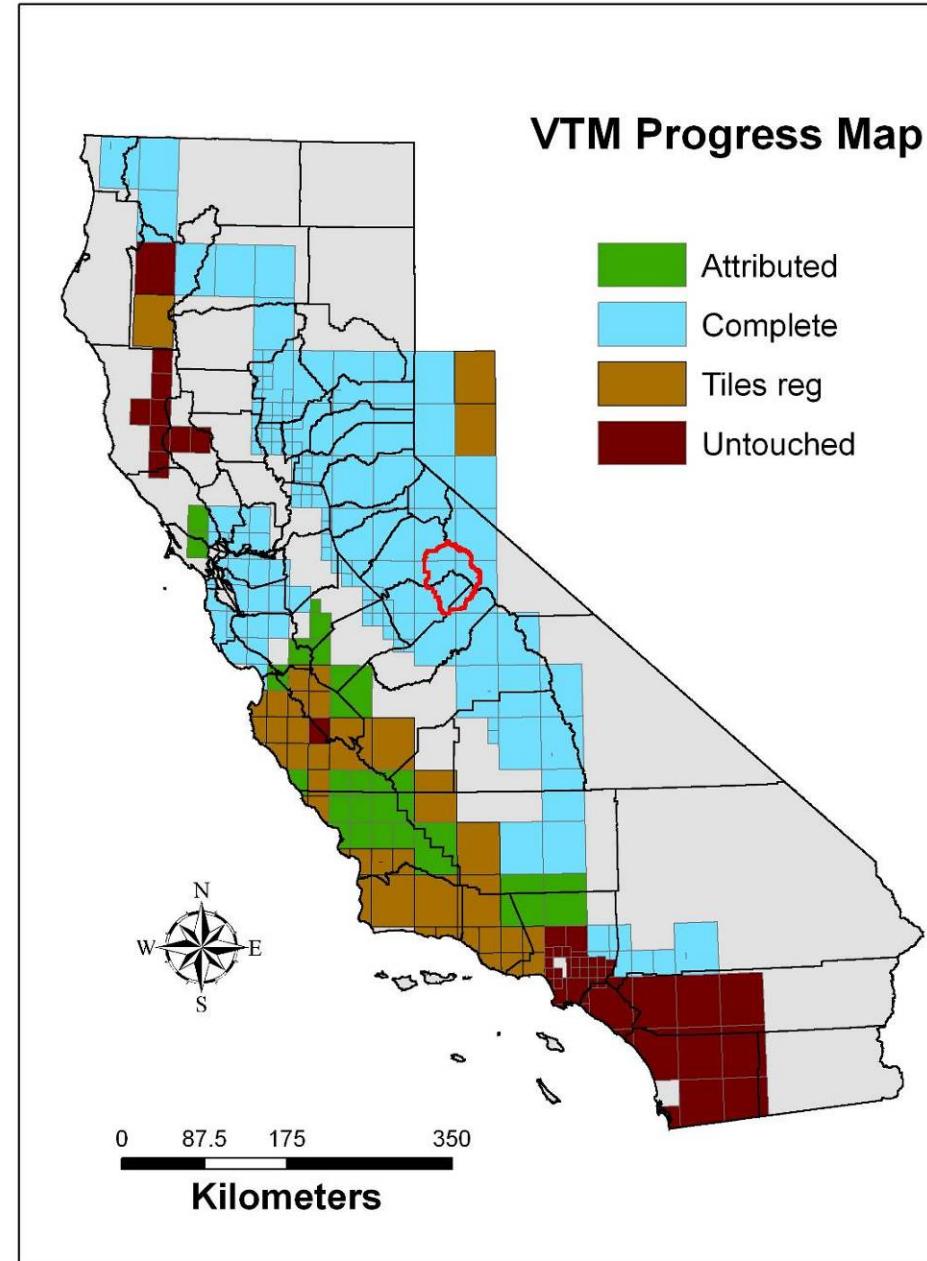
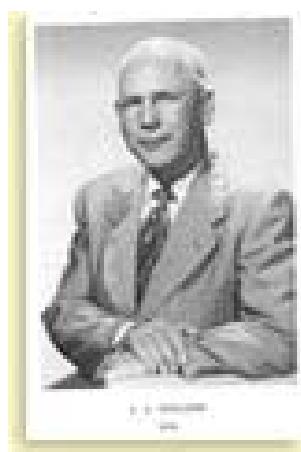
A sneak peak at the Bay Area

The Sierra Nevada overview

Some ideas for integrated monitoring

The Wieslander VTM Project

- Conducted in the 1930s
- Basis for much of current understanding of California Vegetation
- Surveyed Forested Regions of the State

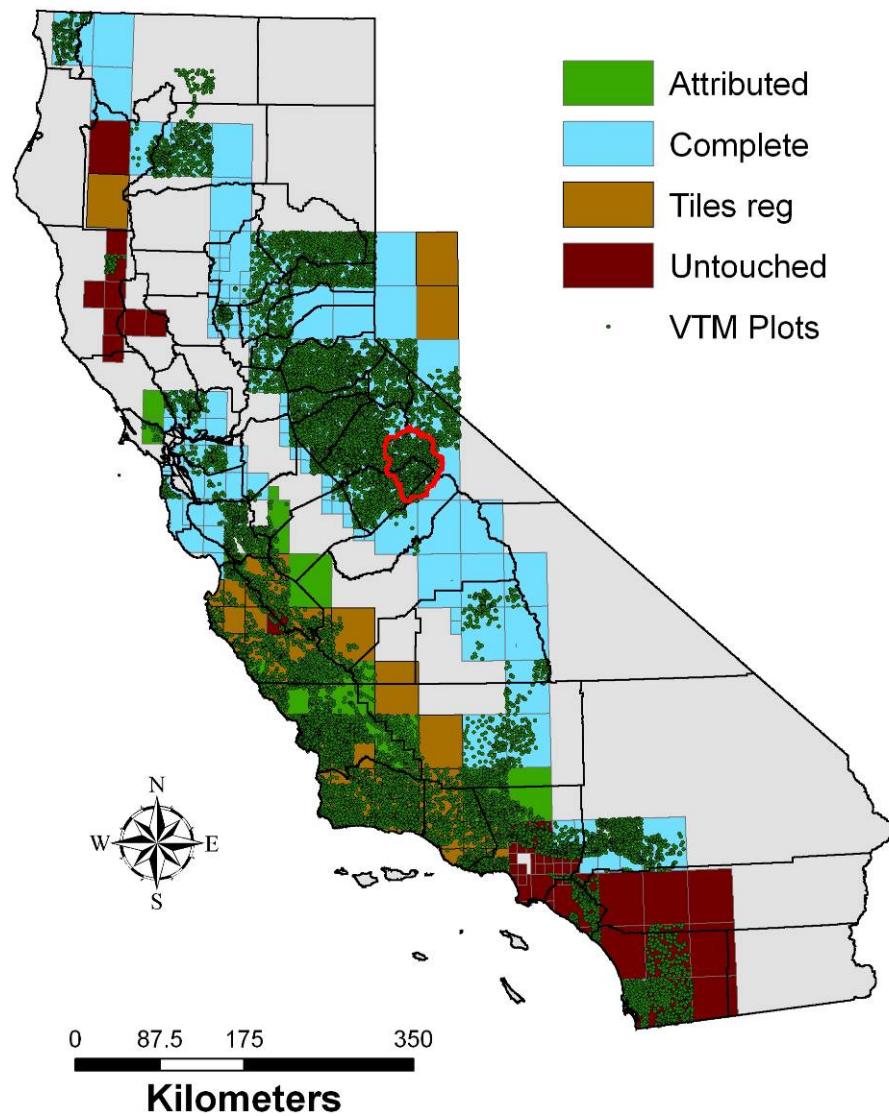


The Wieslander VTM Project

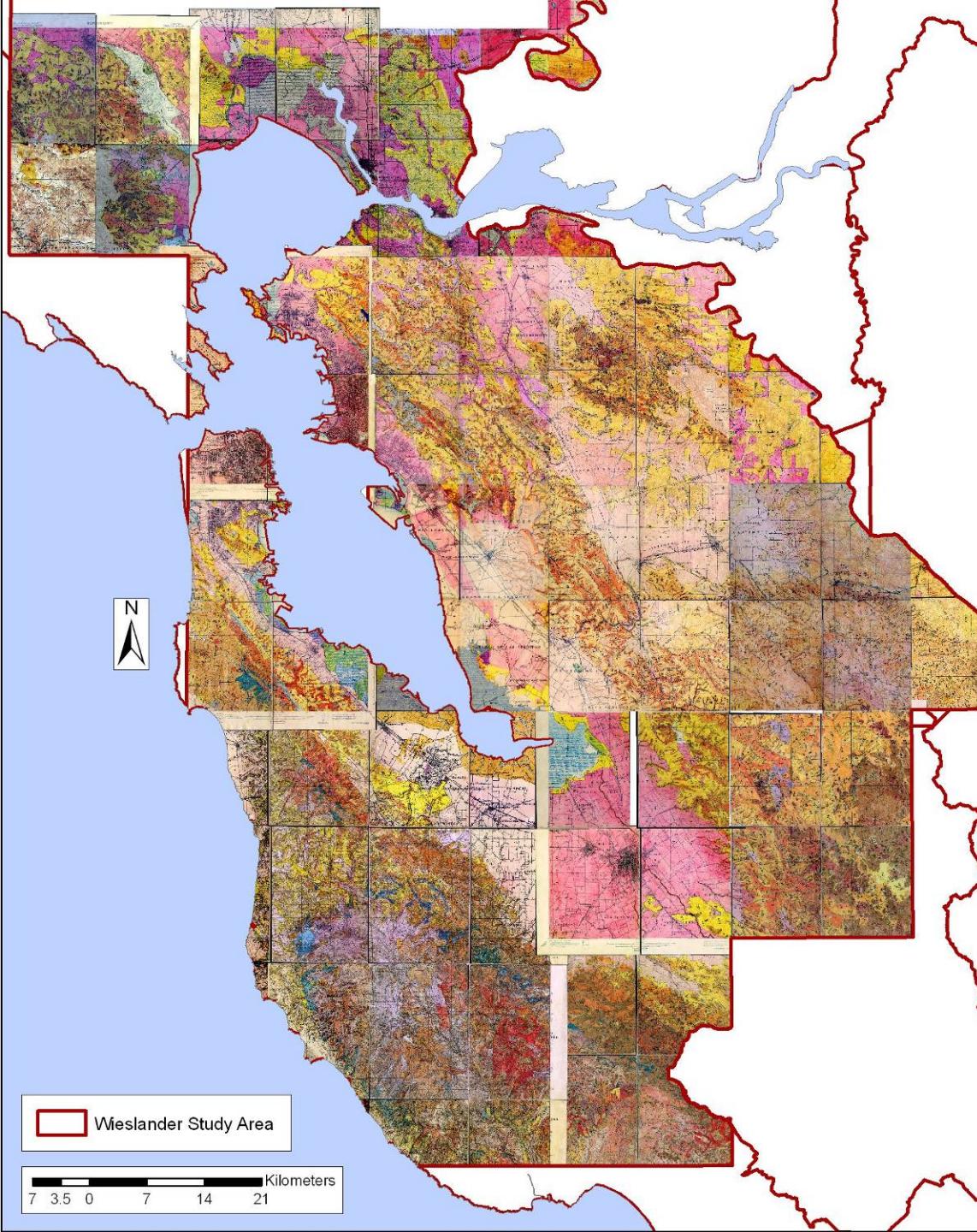
- Mapped 1/3 of the state
- 16,000 vegetation plots
- Over 3000 photographs

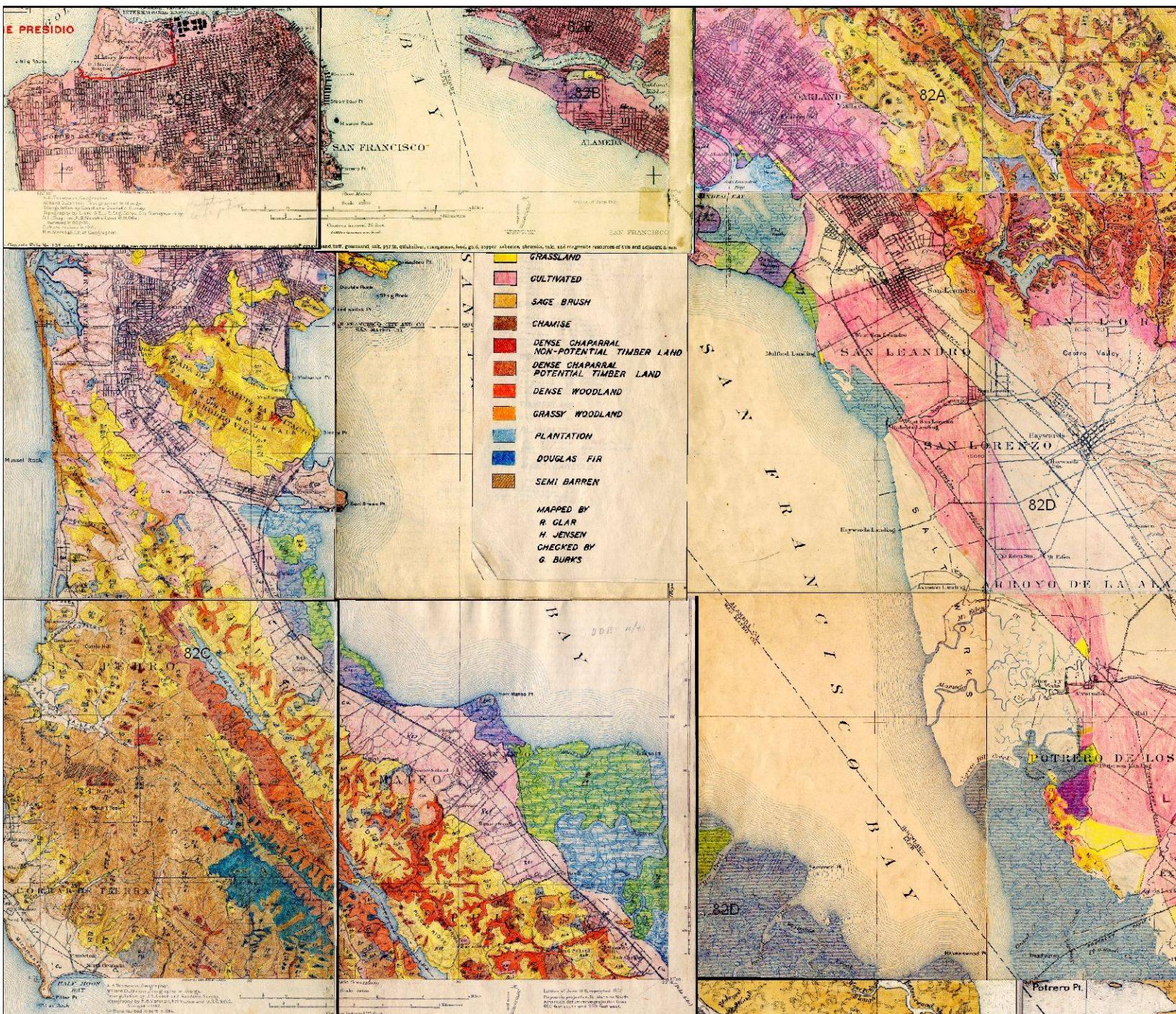


VTM Progress Map



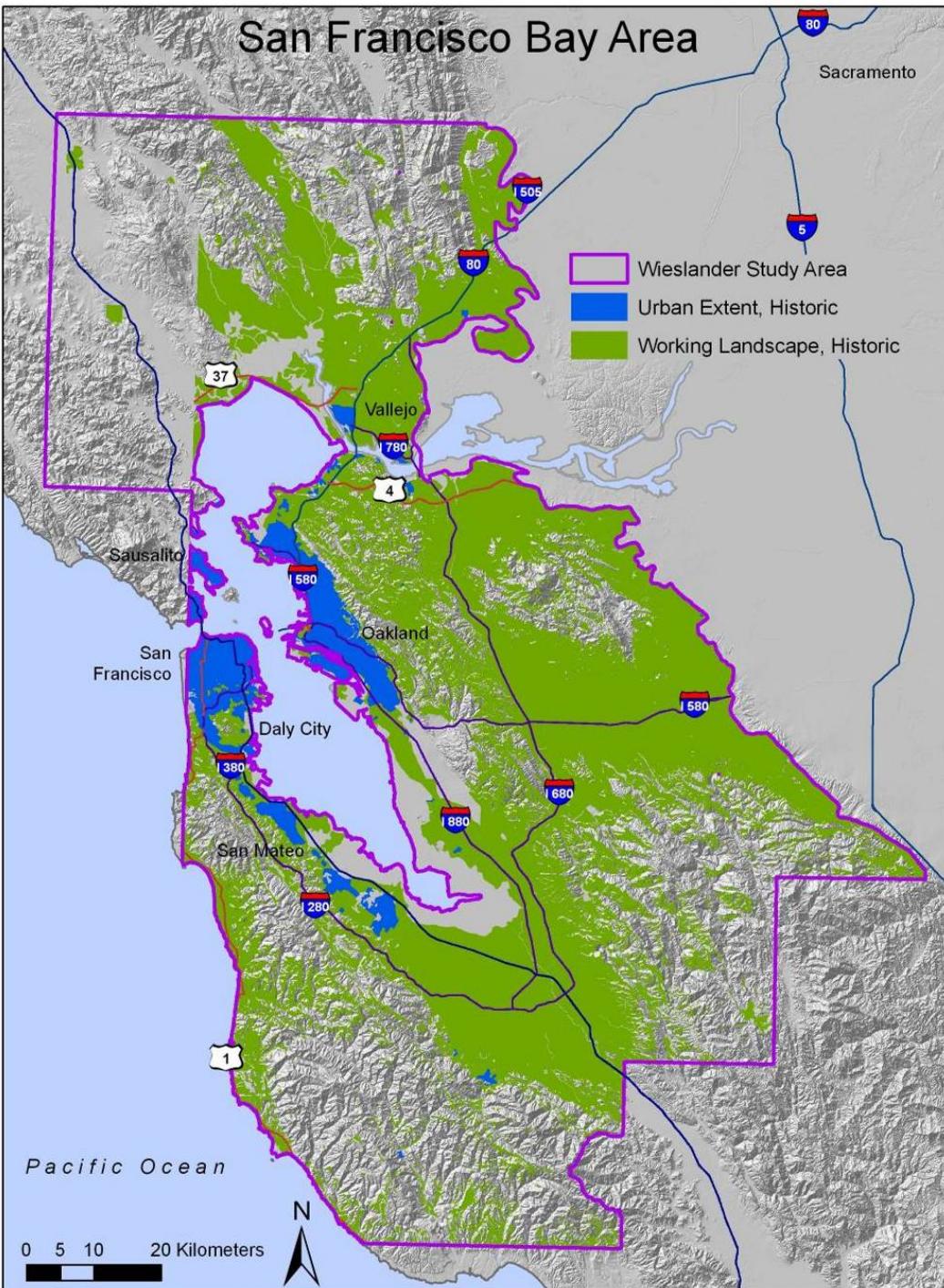
The Bay Area VTM







San Francisco Bay Area

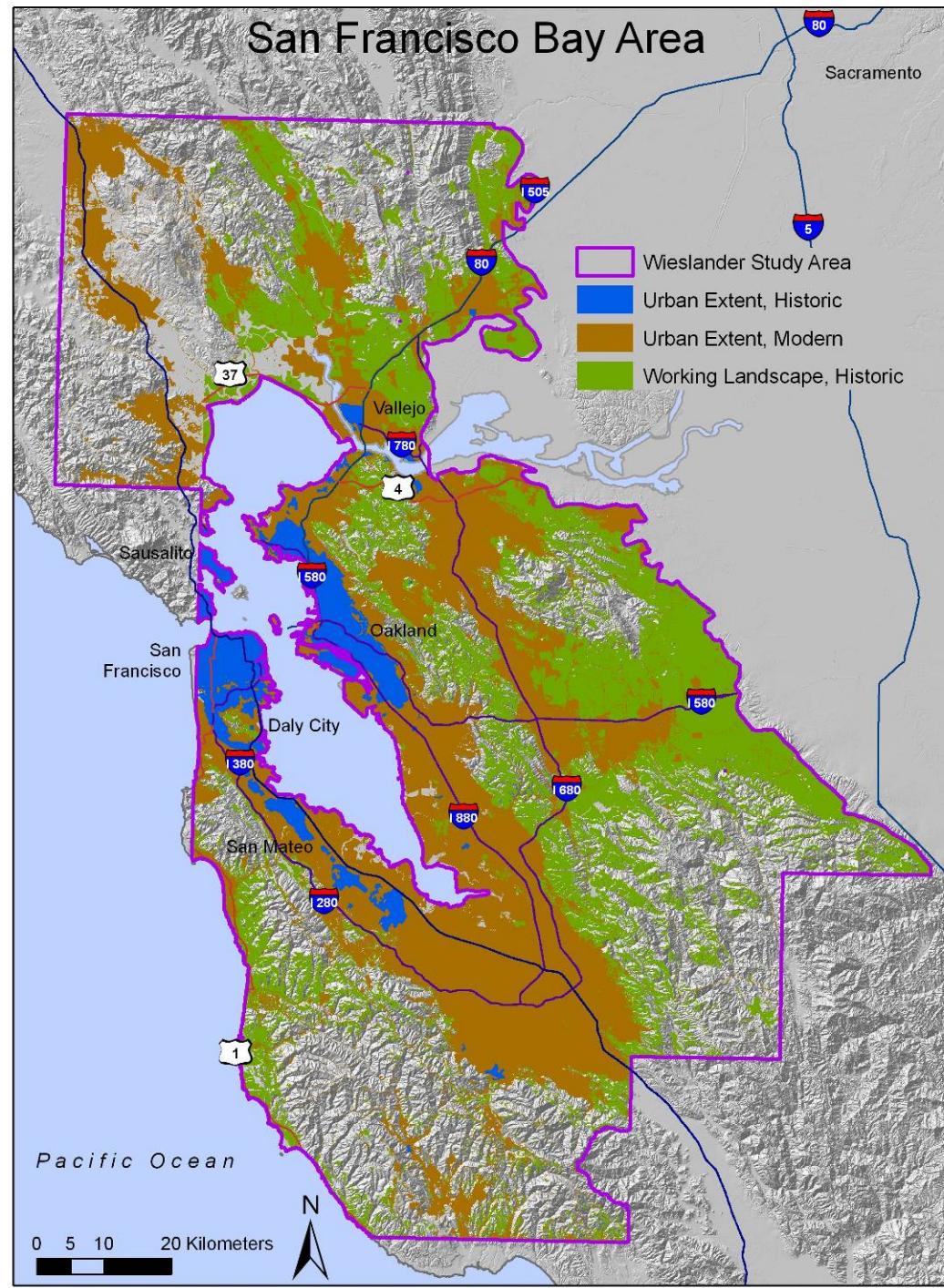


Historic Extents

Urban 392 km^2

Working Landscapes 4771 km^2

San Francisco Bay Area



Historic Extents

Urban 392 km²

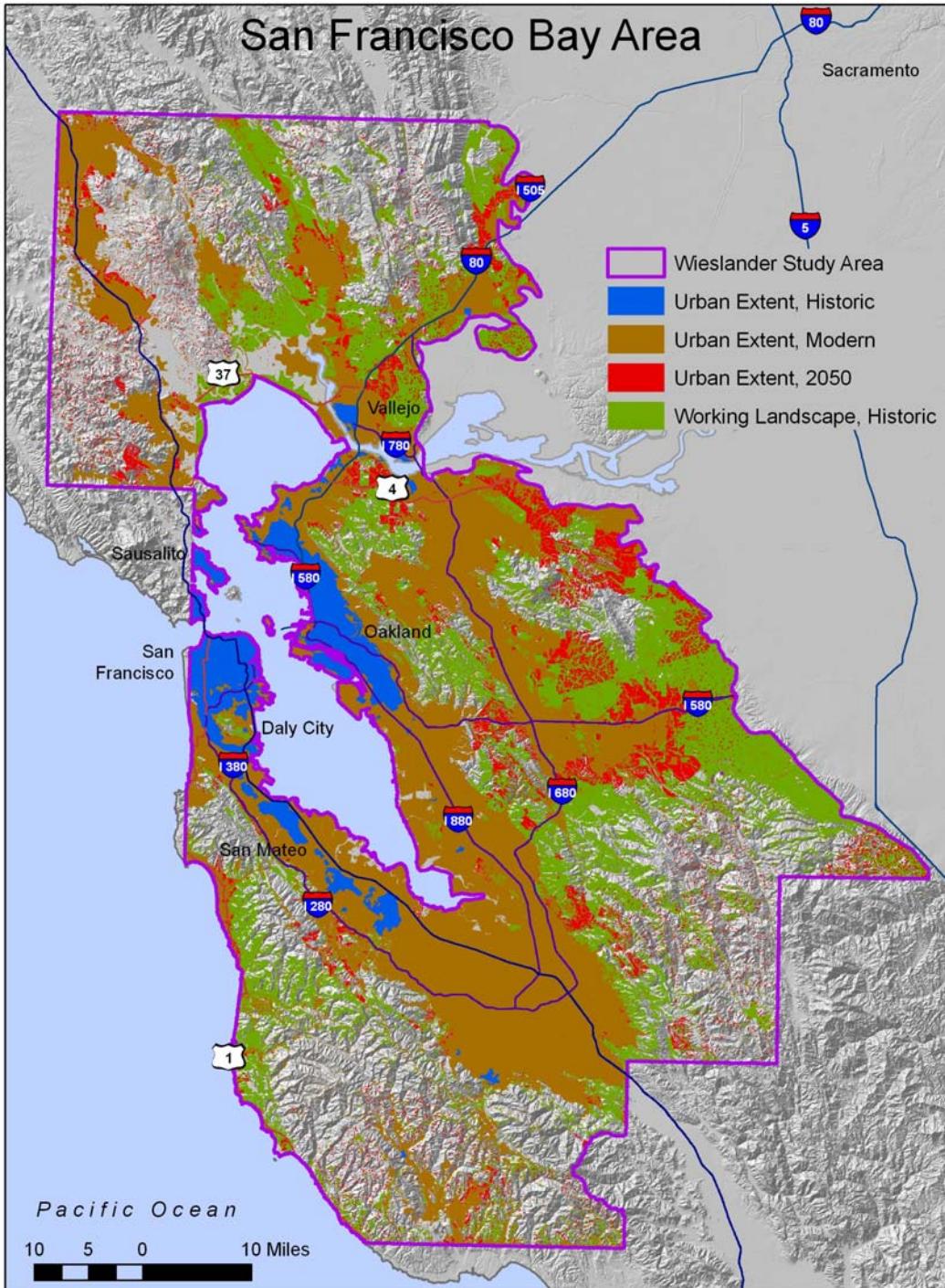
Working Landscapes 4771 km²

Current Extents

Urban 2258 km²

Working Landscapes 2981 km²

San Francisco Bay Area



Historic Extents

Urban 392 km²

Working Landscapes 4771 km²

Current Extents

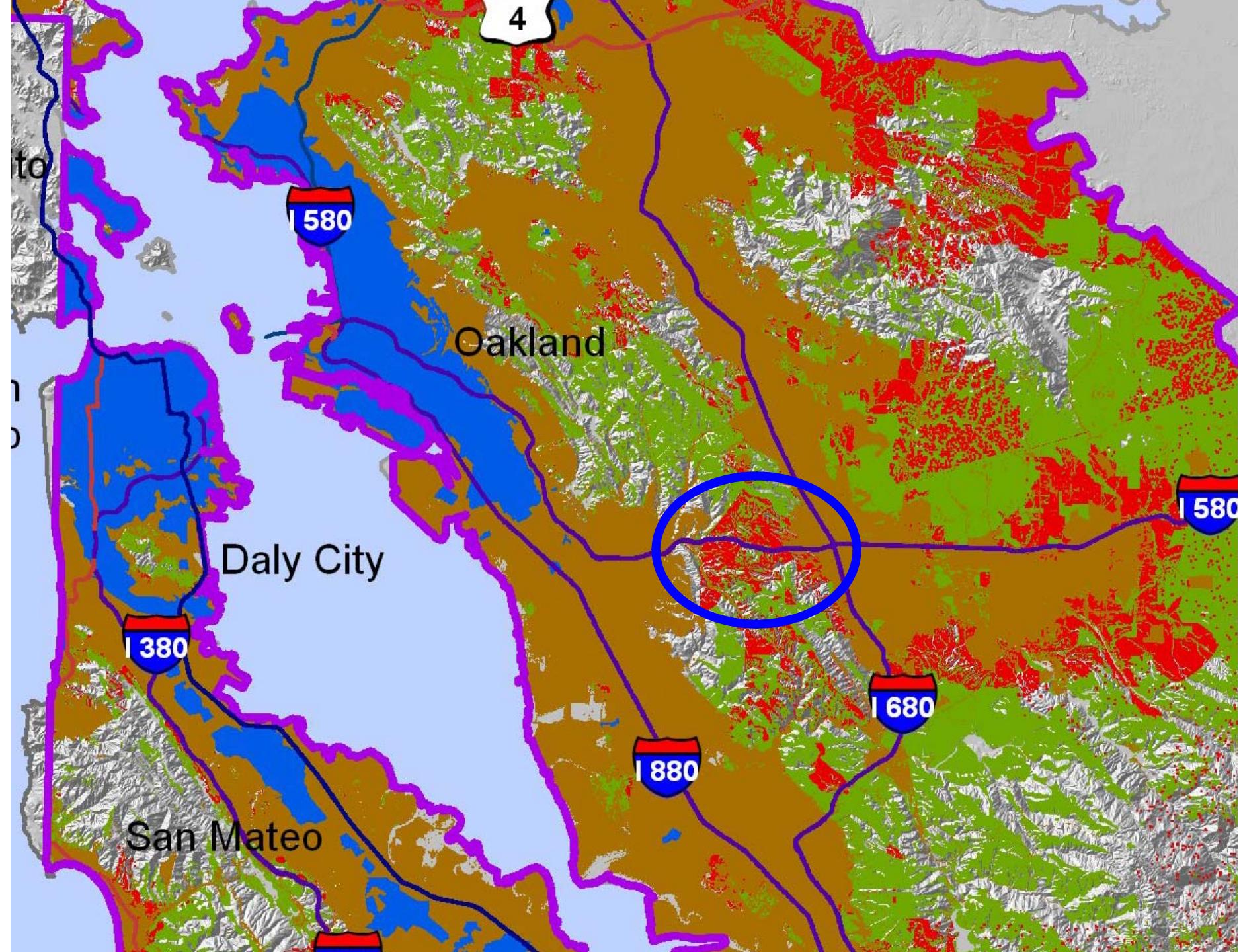
Urban 2258 km²

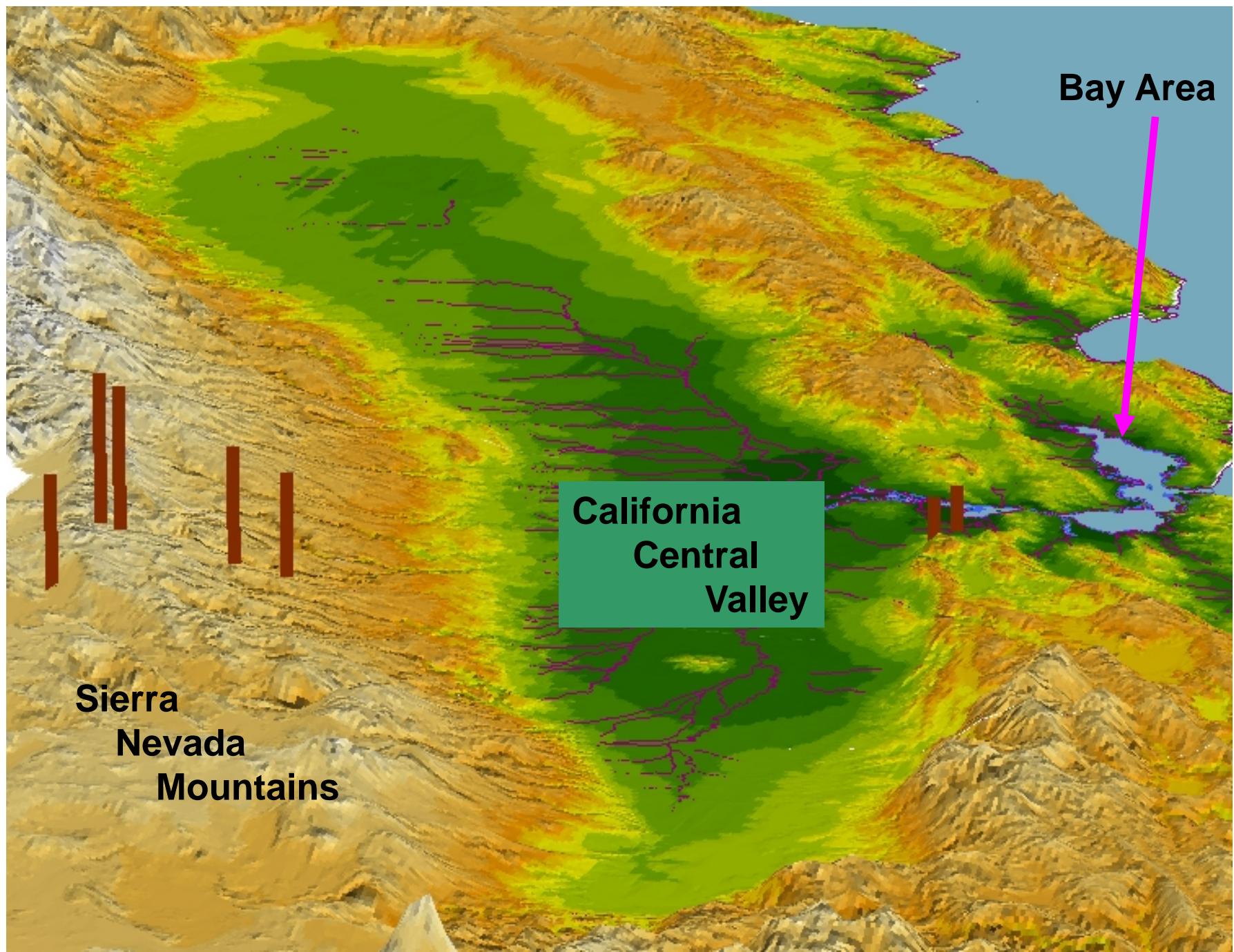
Working Landscapes 2981 km²

Future Extents

Urban + 61 km²

Working Landscapes -36 km²





Terrestrial Plant Response to Climate Change

Mountains as Gradient
Systems
Vertical vs
Horizontal

Species Elevation
Distributions

Leading Edge Dynamic
Easy to record
Dependent on growth

Trailing Edge Dynamic
is messy to detect
mortality/replacement
rapid or slow



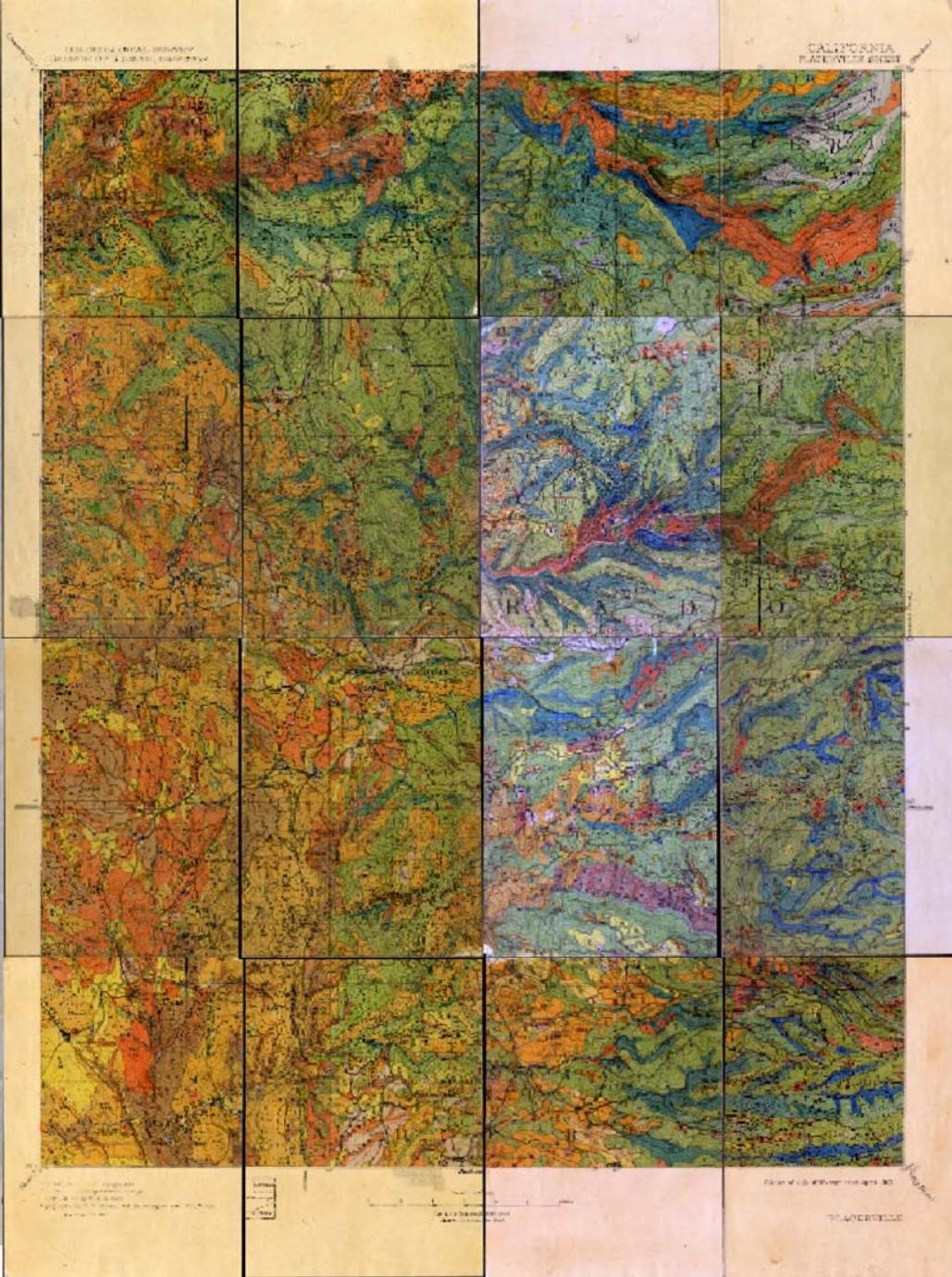
Within Vegetation Band
a vegetation type
can have increased or
decreased



**We used the VTM data
to examine ecotone
and vegetation band
dynamics
along the west flank of
Sierra Nevada, CA.**

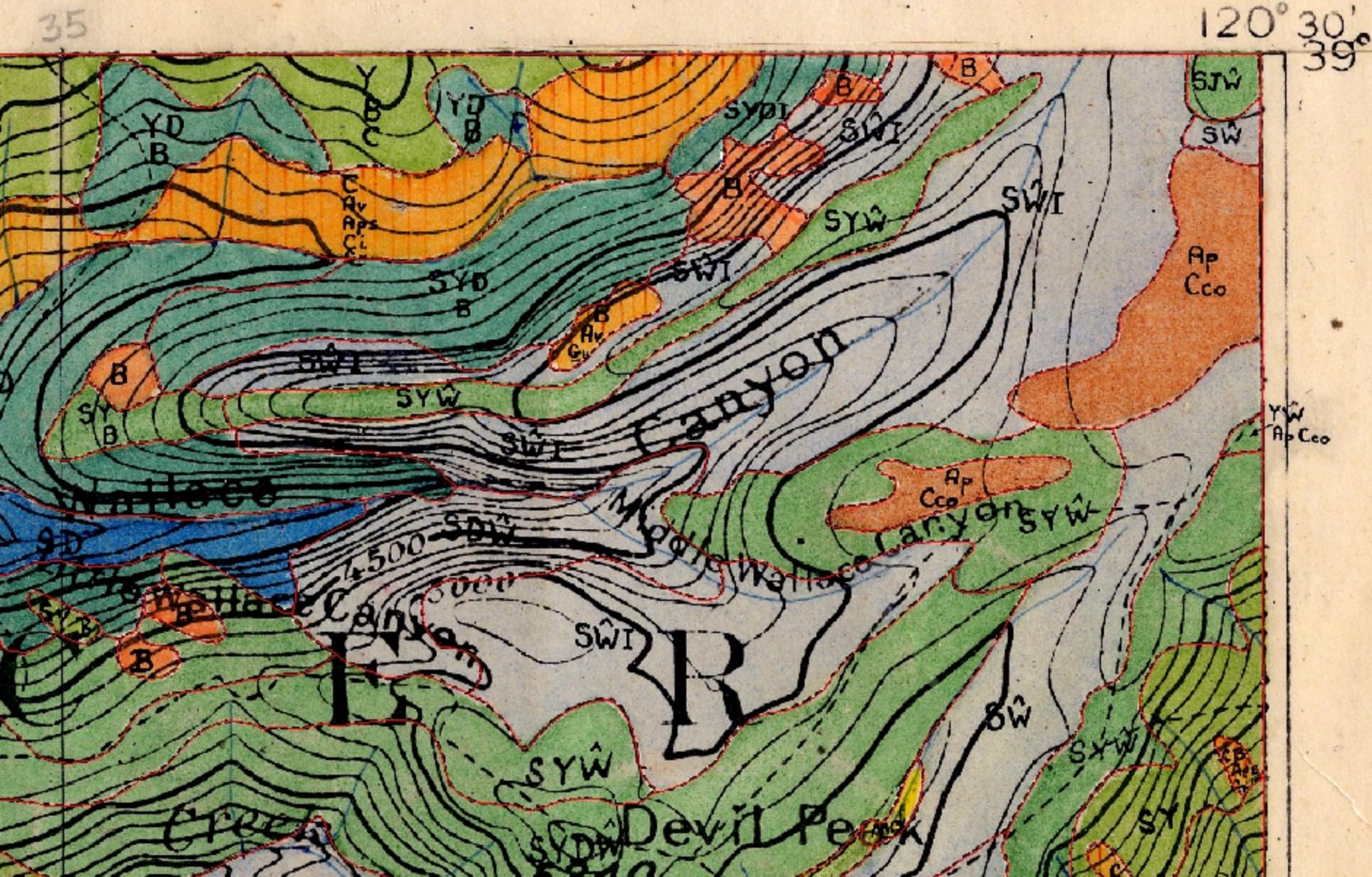
**It required setting a
framework to conduct
integrative analyses**

CALIFORNIA
PALEOZOIC



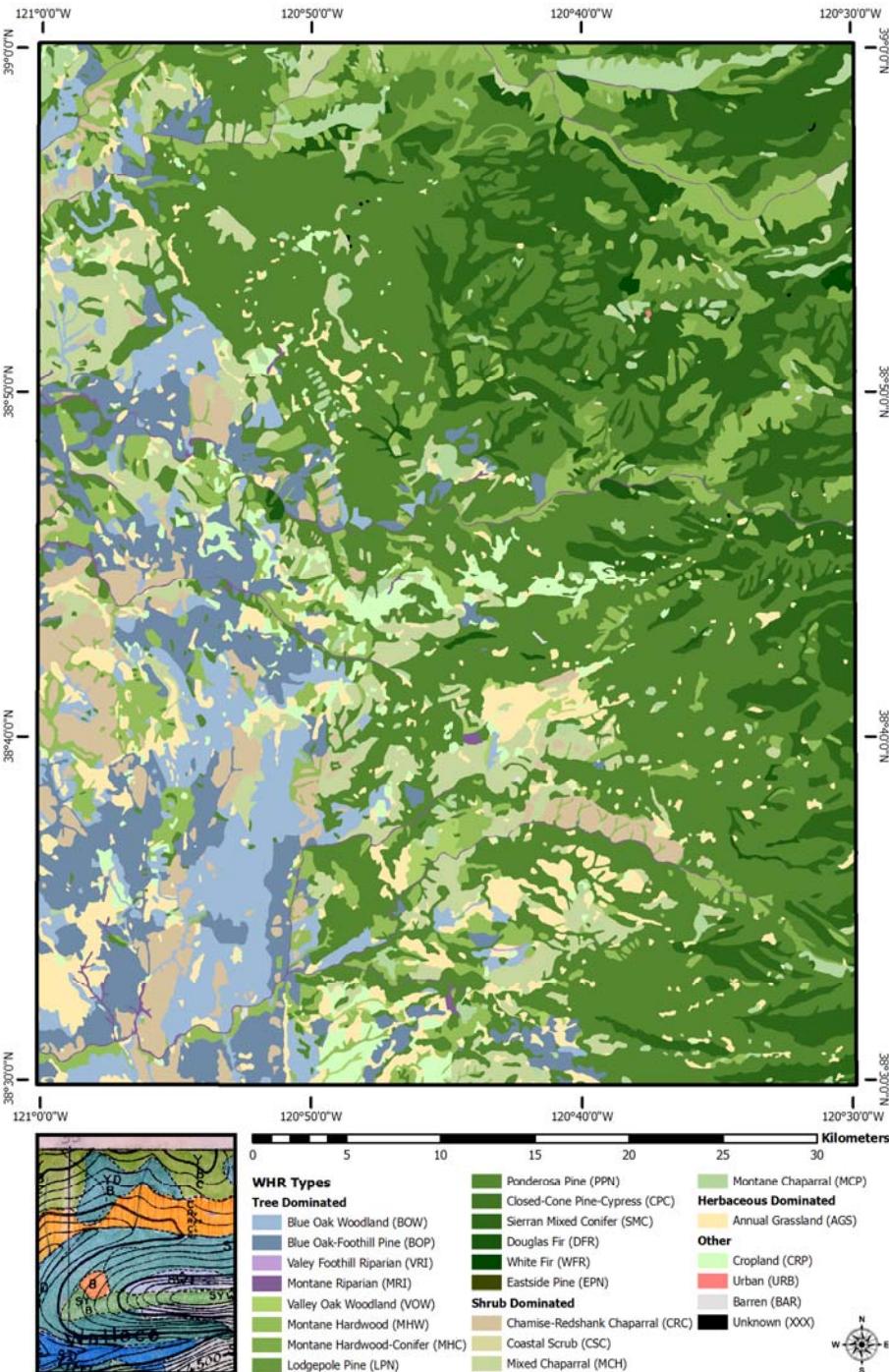
VTMs
1934

CALIFORNIA PLACERVILLE SHEET



Work
Work
Work





Fully converted VTM quad

Can be queried by species or vegetation type

Species combinations Were converted to

California Wildlife Habitat Relationships-

a habitat classification that names certain species

12,000'

Western Slope of the Sierra

10,000'

8,000'

6,000'

4,000'

2,000'

300'

12,000'

Eastern Slope of the Sierra

10,000'

8,000'

6,000'

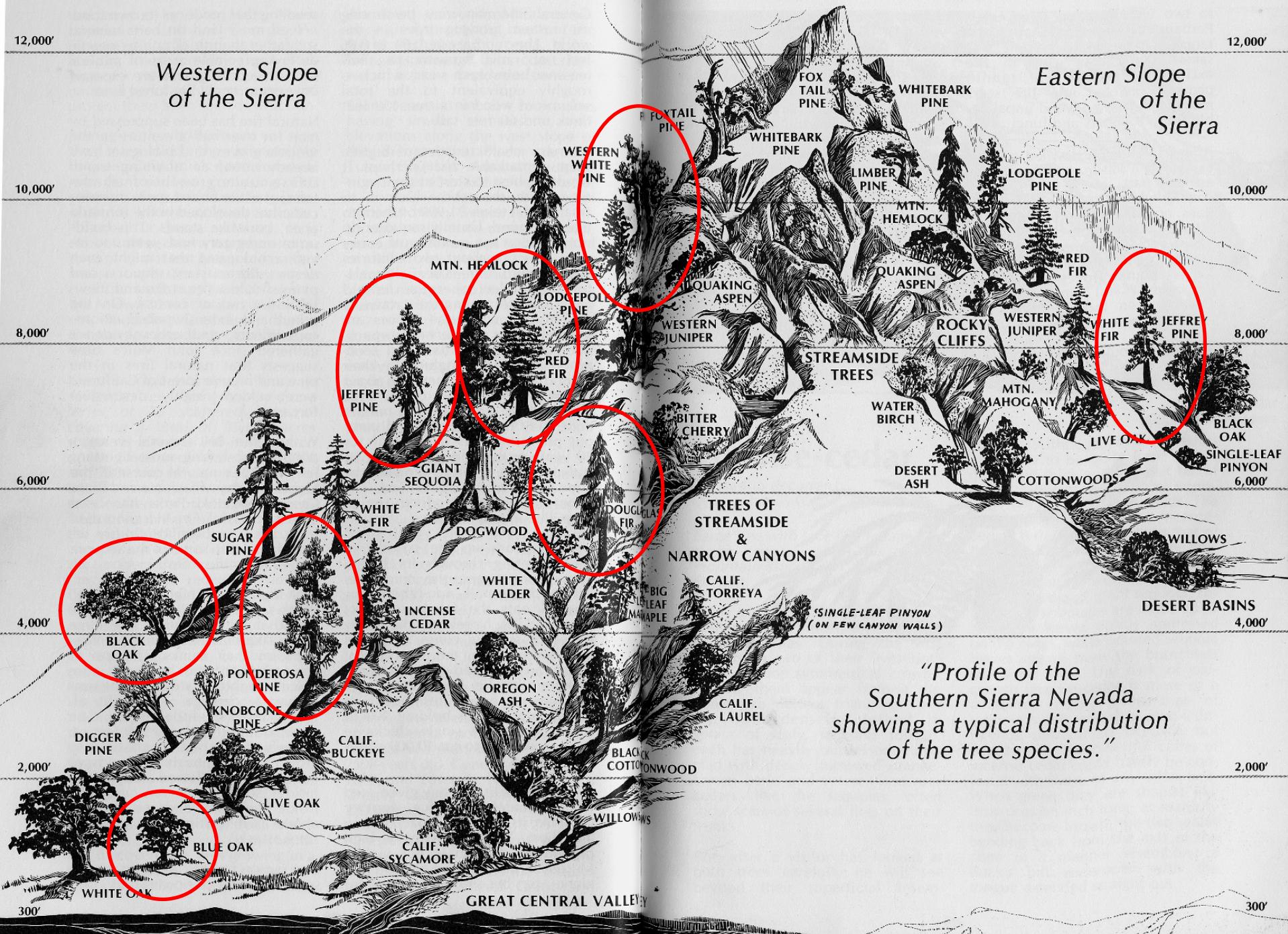
4,000'

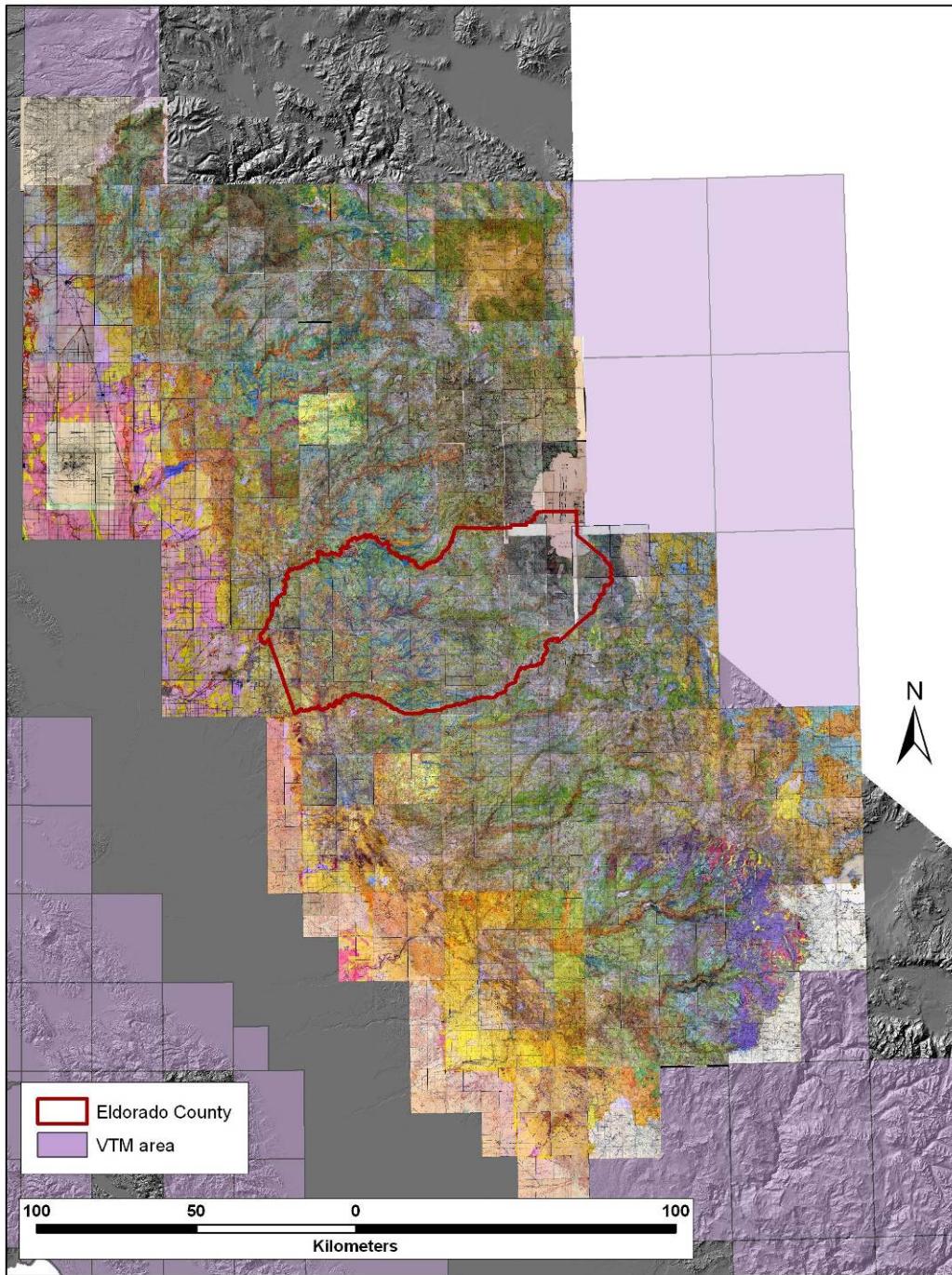
2,000'

300'

TREES OF STREAMSIDE & NARROW CANYONS

*"Profile of the
Southern Sierra Nevada
showing a typical distribution
of the tree species."*

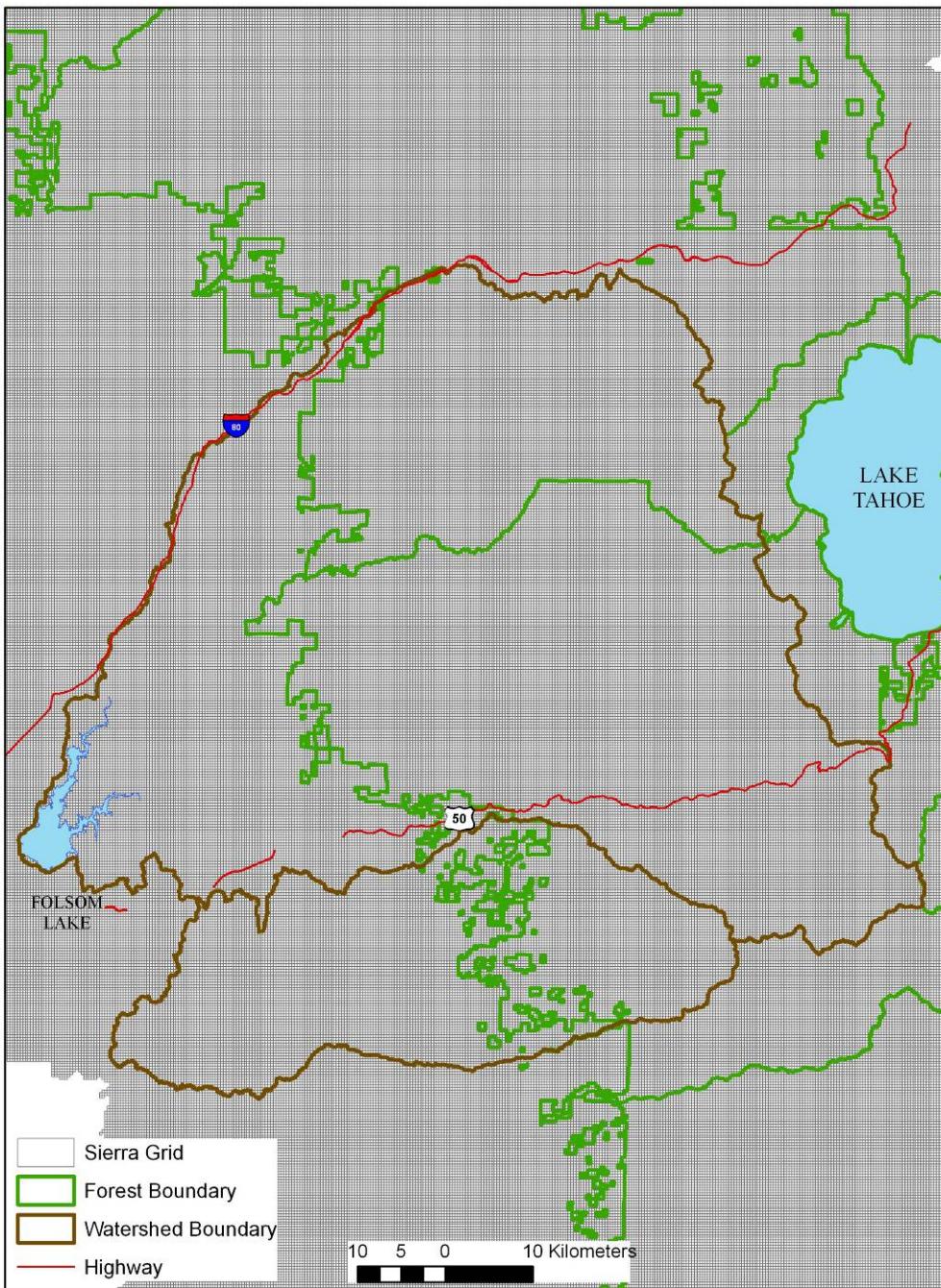




Study Area Central & Northern Sierra

Analytical framework
development

Central Sierra 300-meter Grid



Construction of landscape analysis framework:

For every cell add:

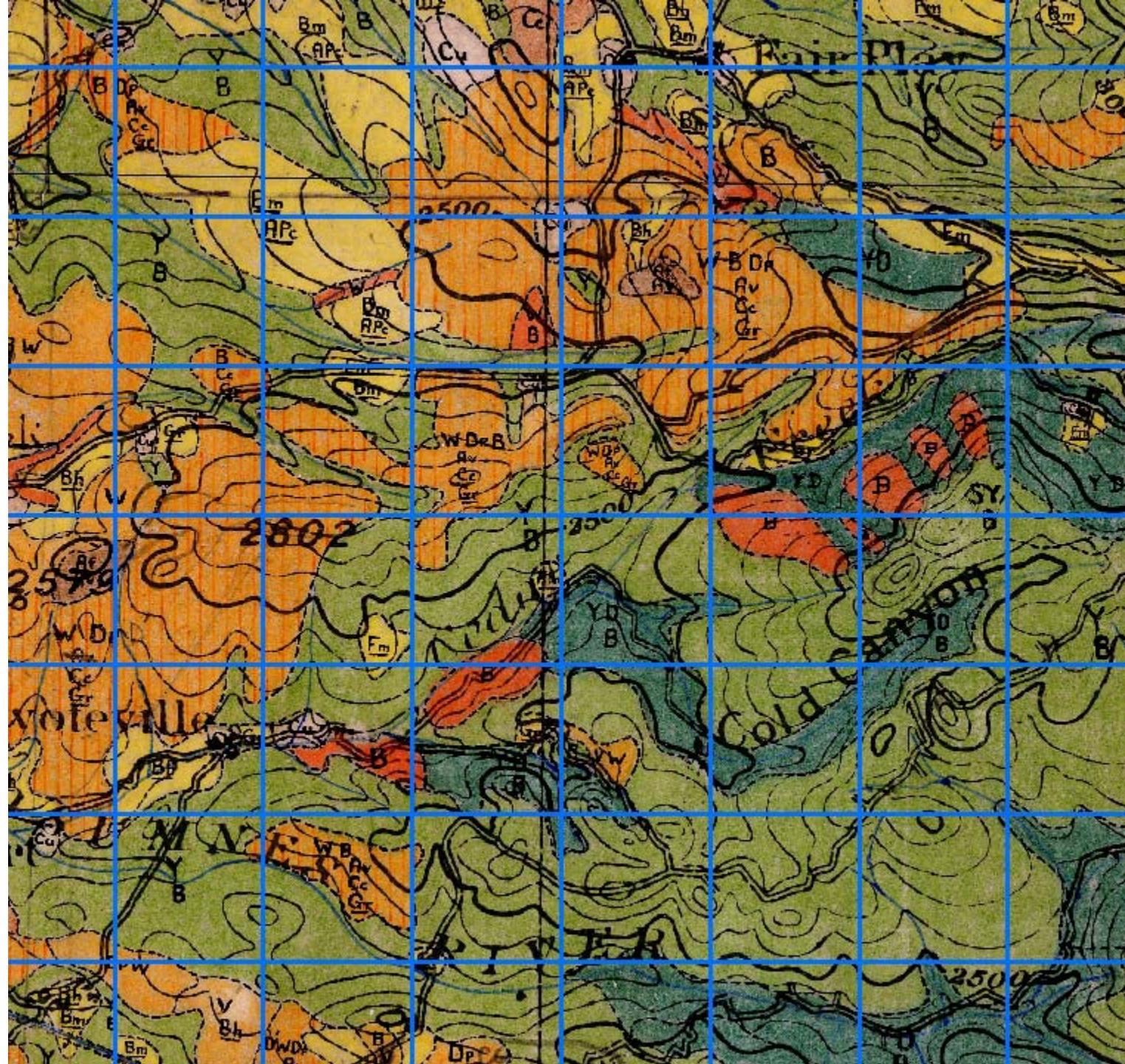
Dominant Vegetation T1, T2

Weather Data T1, T2

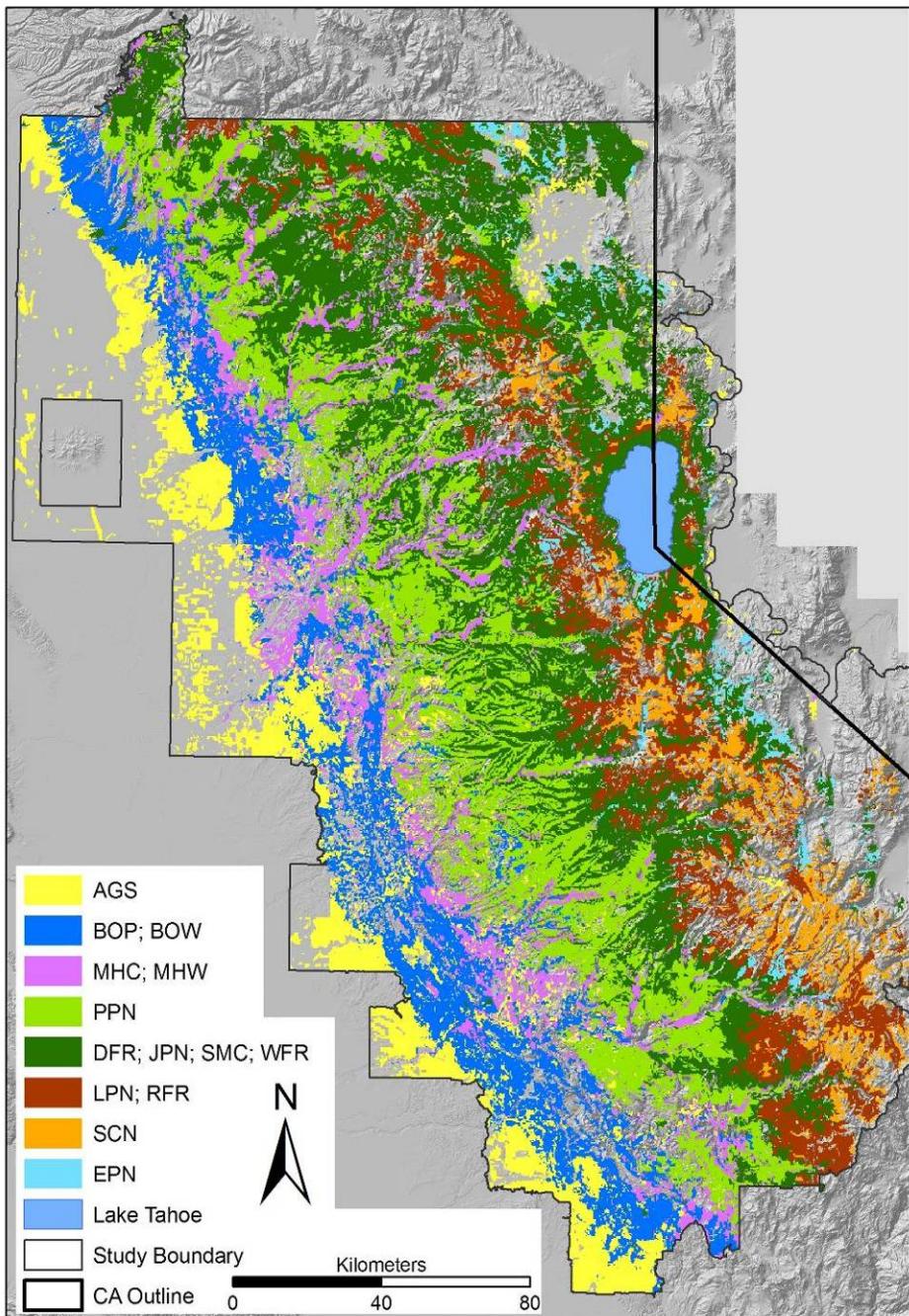
Environmental variables

e.g. topographic roughness
aspect
slope
solar radiation
geology
of fires

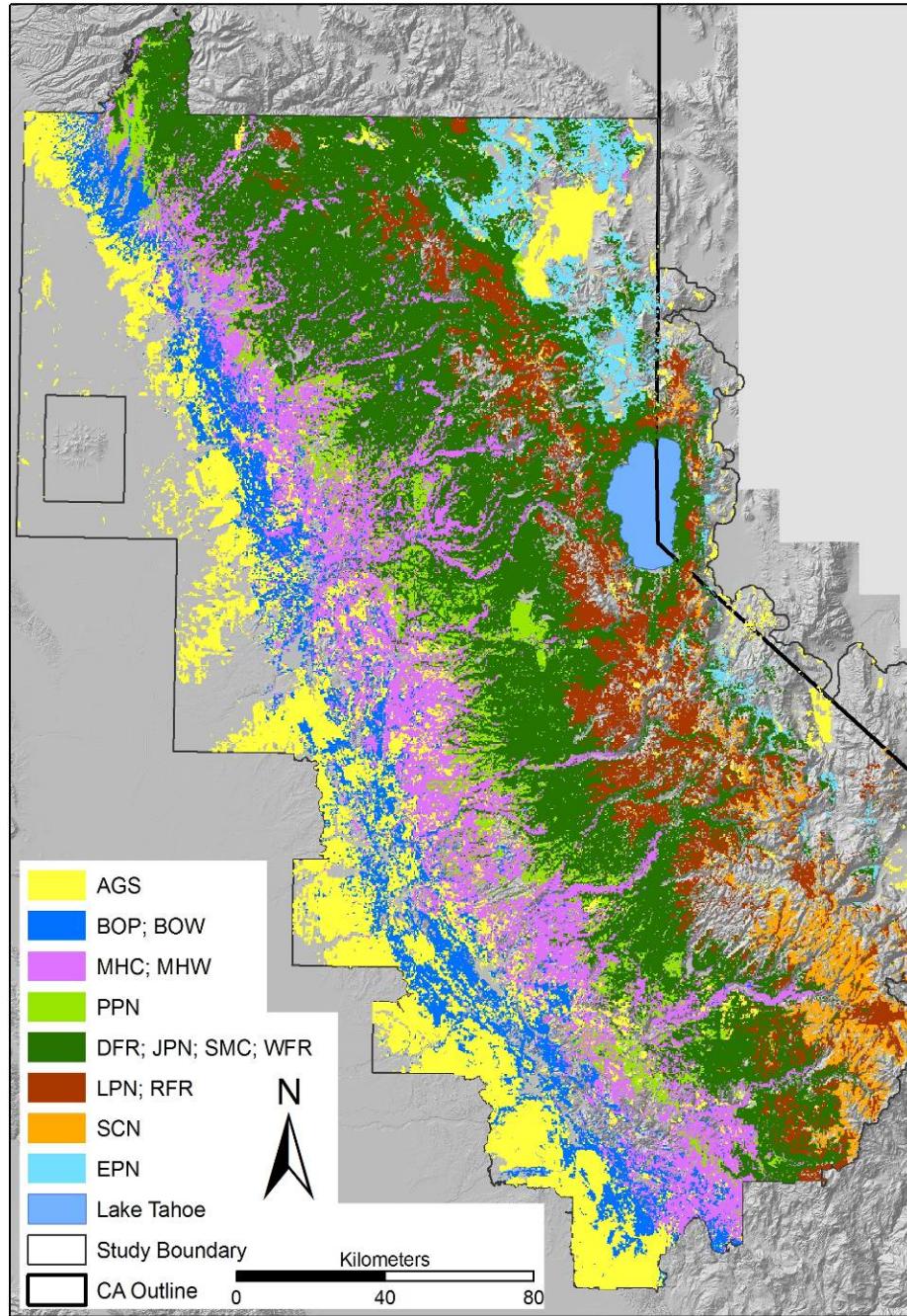
Climate data from Parra & Monihan 2008 GCB



Historic WHR Types



Current WHR Types



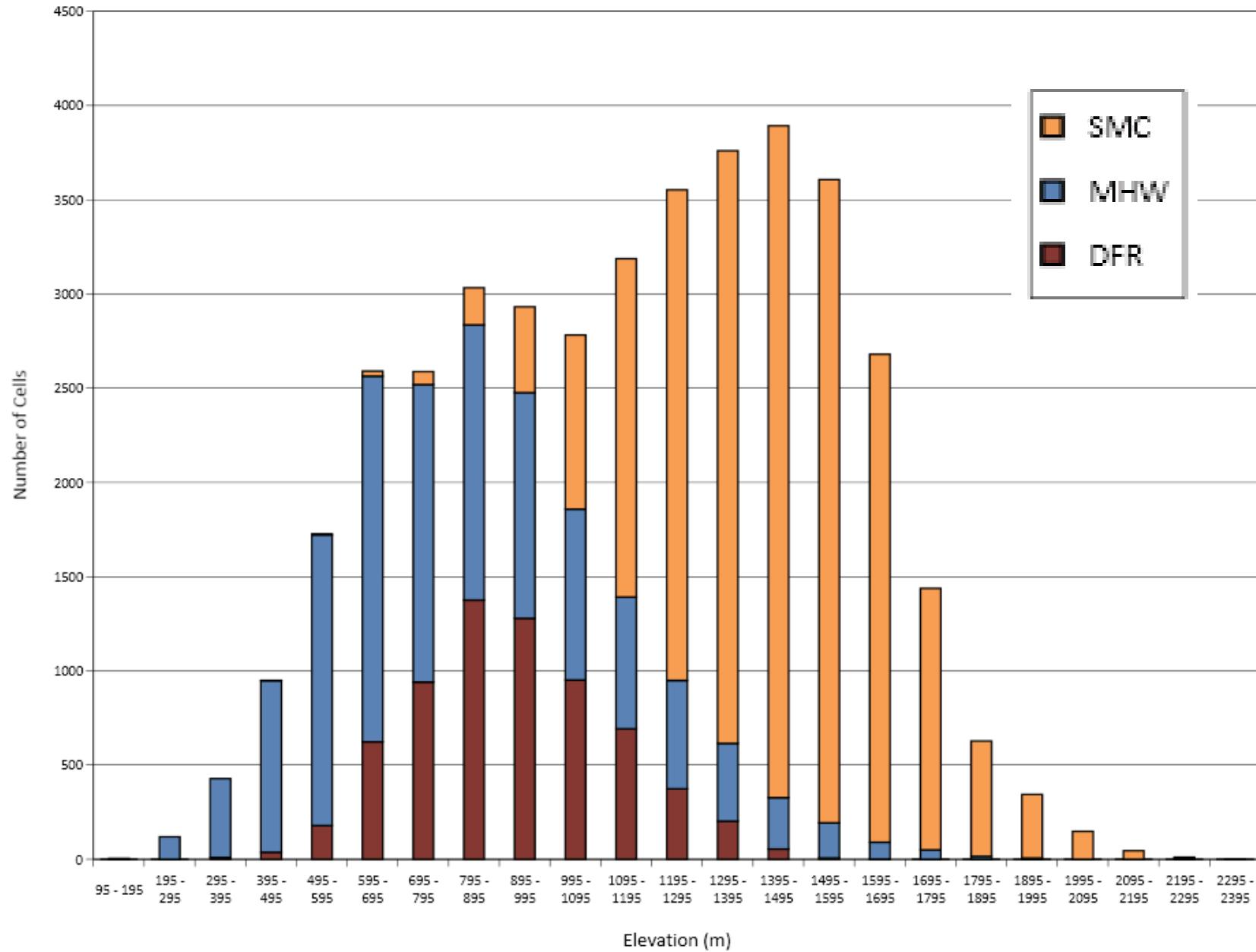
Winners

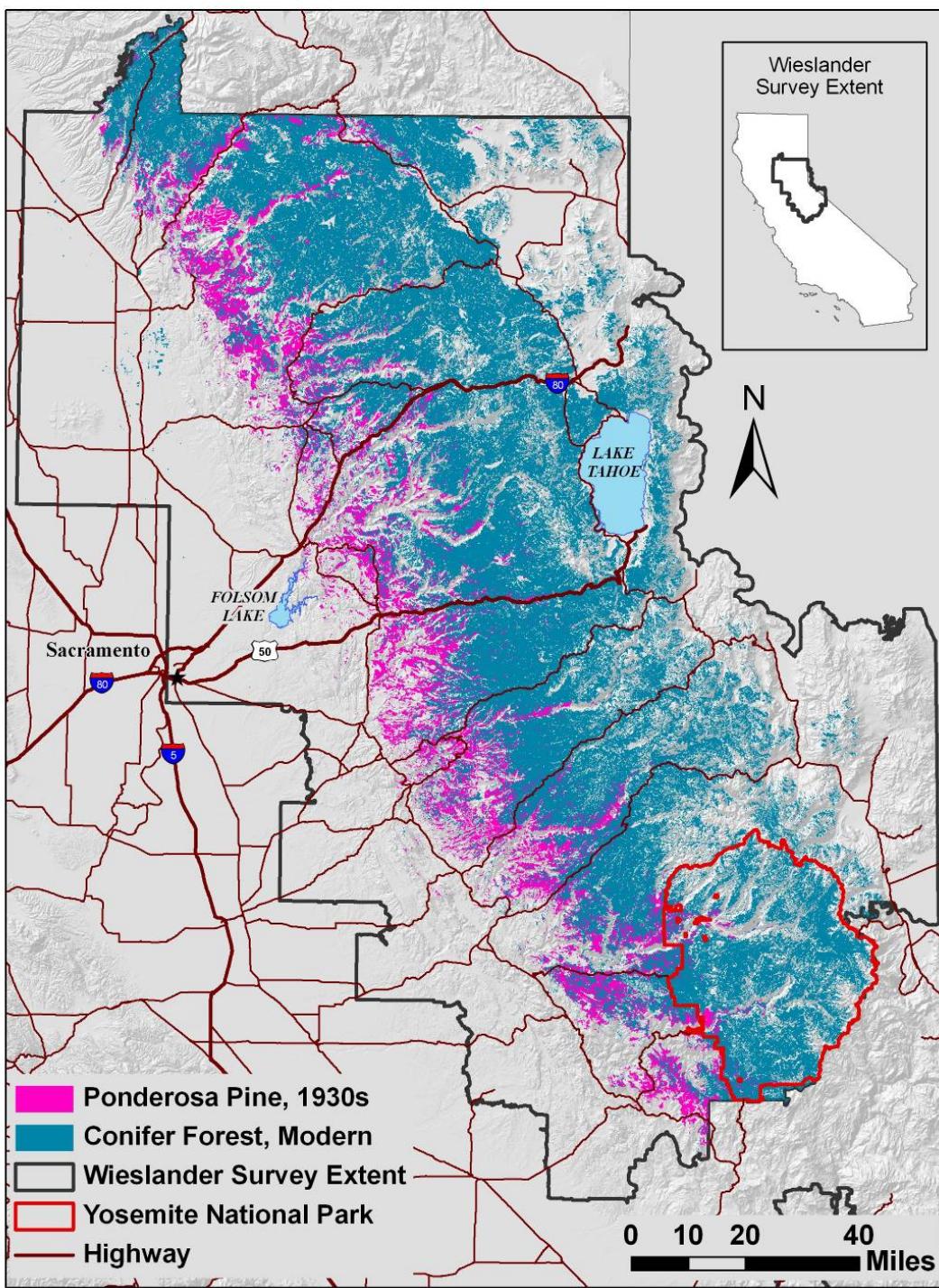
Wildlife Habitat Relations Indices	Historic Area (km ²)	Current Area (km ²)	Differen ce (km ²)
Sierra Mixed Conifer	2,631	8,096	5,464
Annual Grassland	4,188	5,710	1,522
Montane Hardwood Conifer	47	1,496	1,449
Urban	57	1,382	1,324
Montane Hardwood	2,651	3,926	1,275

Losers

Agriculture	4,020	3,133	(887)
Blue Oak Foothill Pine	4,078	3,039	(1,038)
Jeffery Pine	3,703	561	(3,141)
Ponderosa Pine	5,662	1,752	(3,909)

Upper Edge							
WHR Type	Elevation Change vs Time (m)	Elevation Change vs Latitude (m)	t value - Time	t value - Lat	p value - Time	p value - Lat	
Ponderosa Pine	-381.4	-75.8	33.06	-8.32	0	0	
Montane Hardwood	15.9	-15.9	-1.16	-1.16	0.25	0.25	
Lower Edge							
Sierra Mixed Conifer	-180.8	-192.9	17.14	-26.11	0	0	
Ponderosa Pine	116.2	-131.1	-19.8	-21.07	0	0	
Montane Hardwood	-10	-28.3	1.88	-4.15	0.06	0	

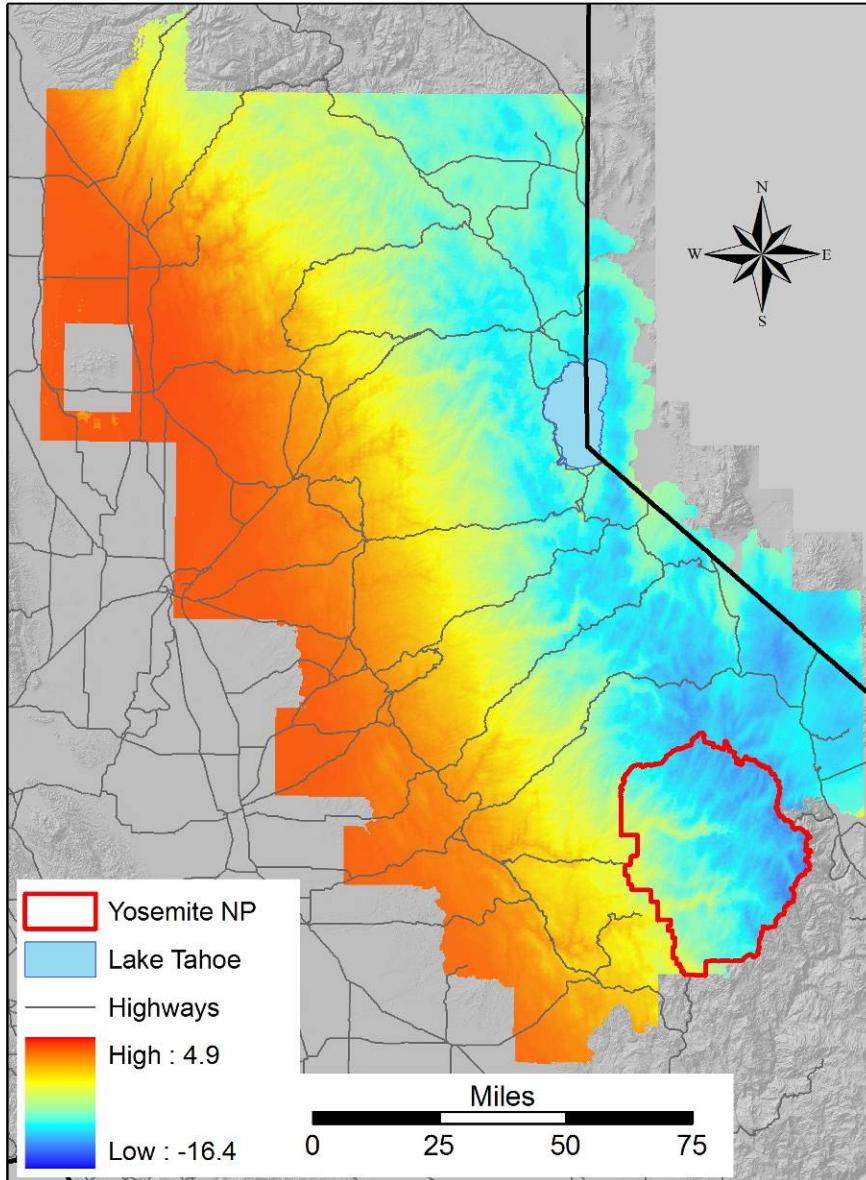




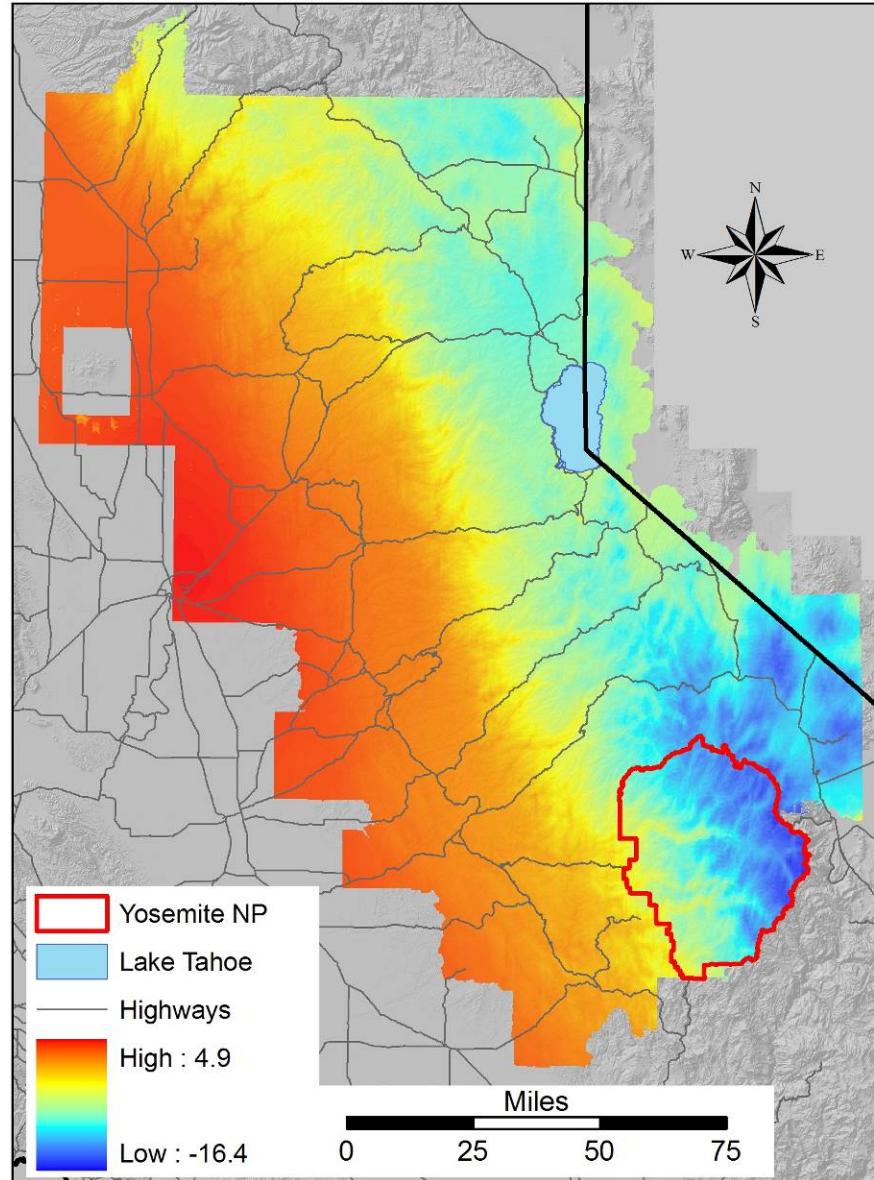
Ponderosa Pine Transition

Lower Edge

Winter Minimum Temperatures - December, January, February



1920 Data*

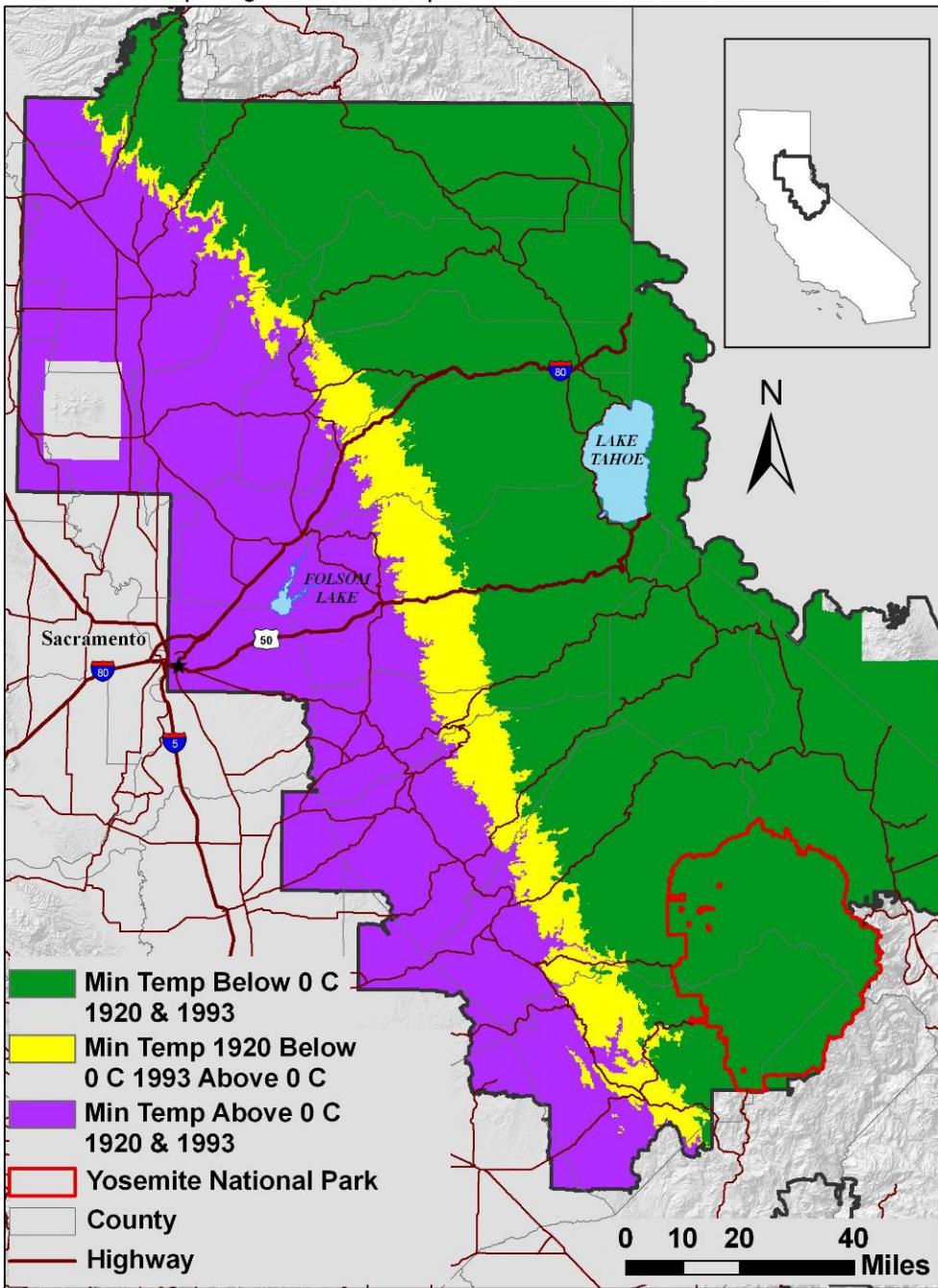


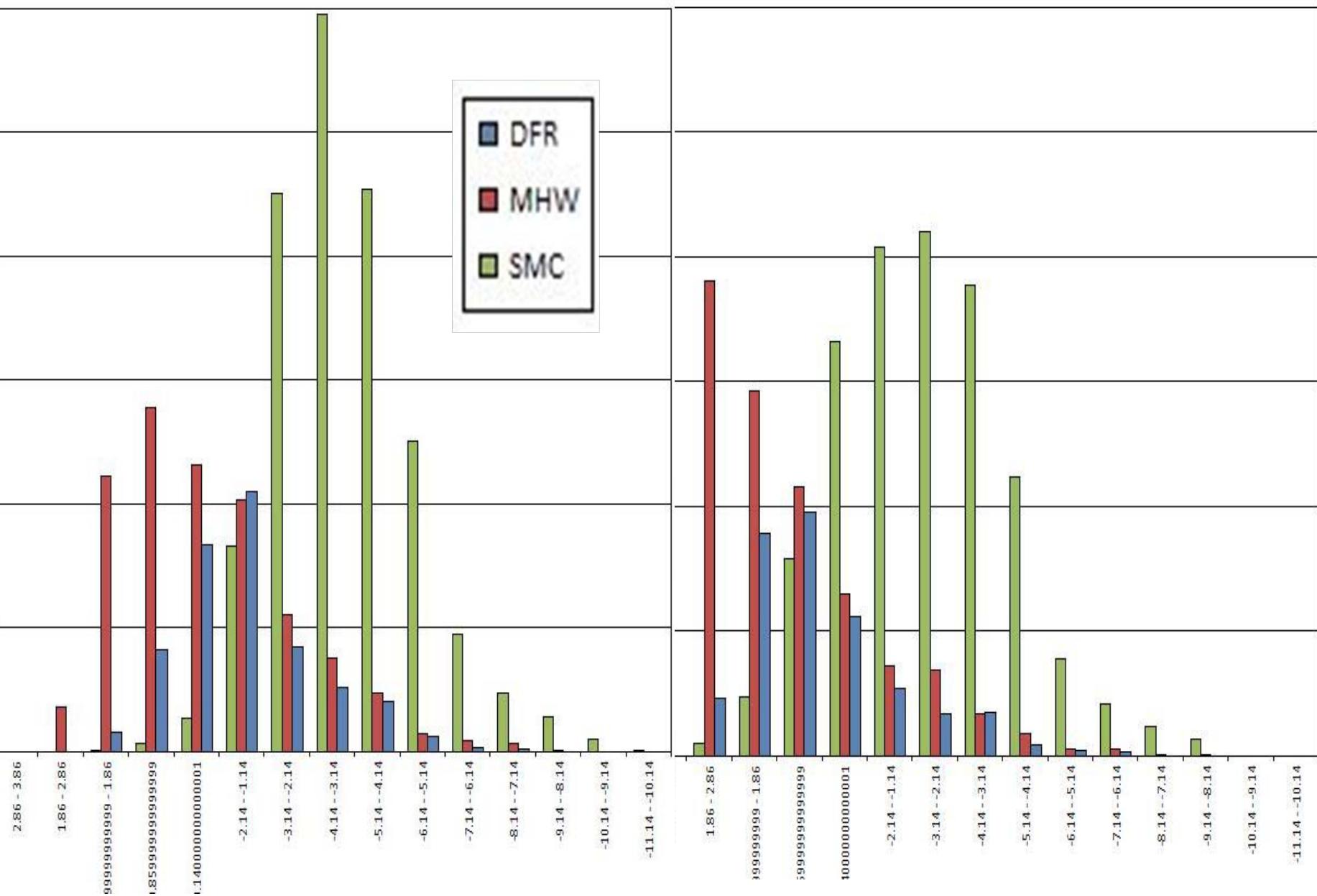
1993 Data*

*1920 data is the average between 1900-1940; 1993 data is the average between 1980-2006

Winter Freeze Line - Dec, Jan and Feb

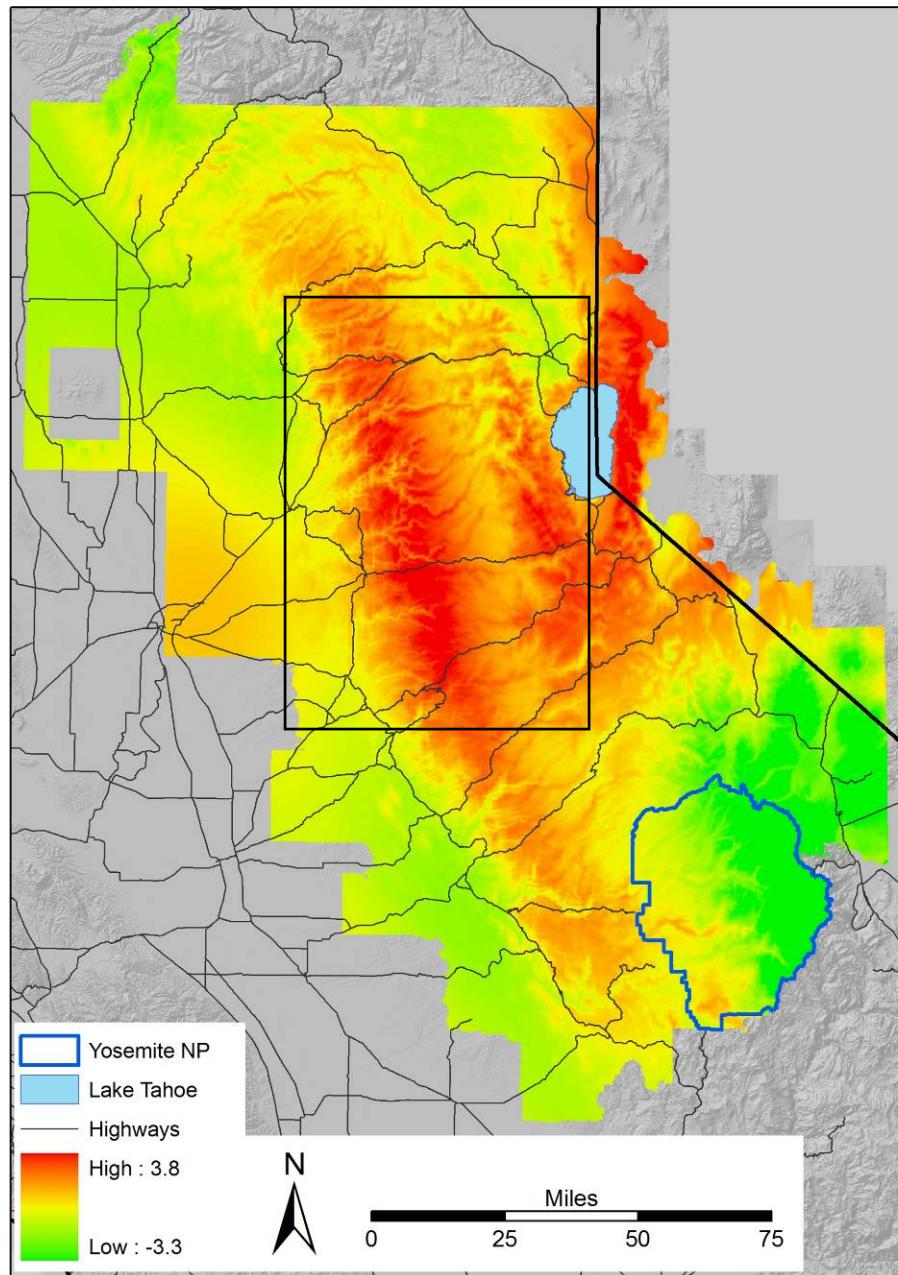
Comparing Minimum Temperatures Between 1920 and 1993





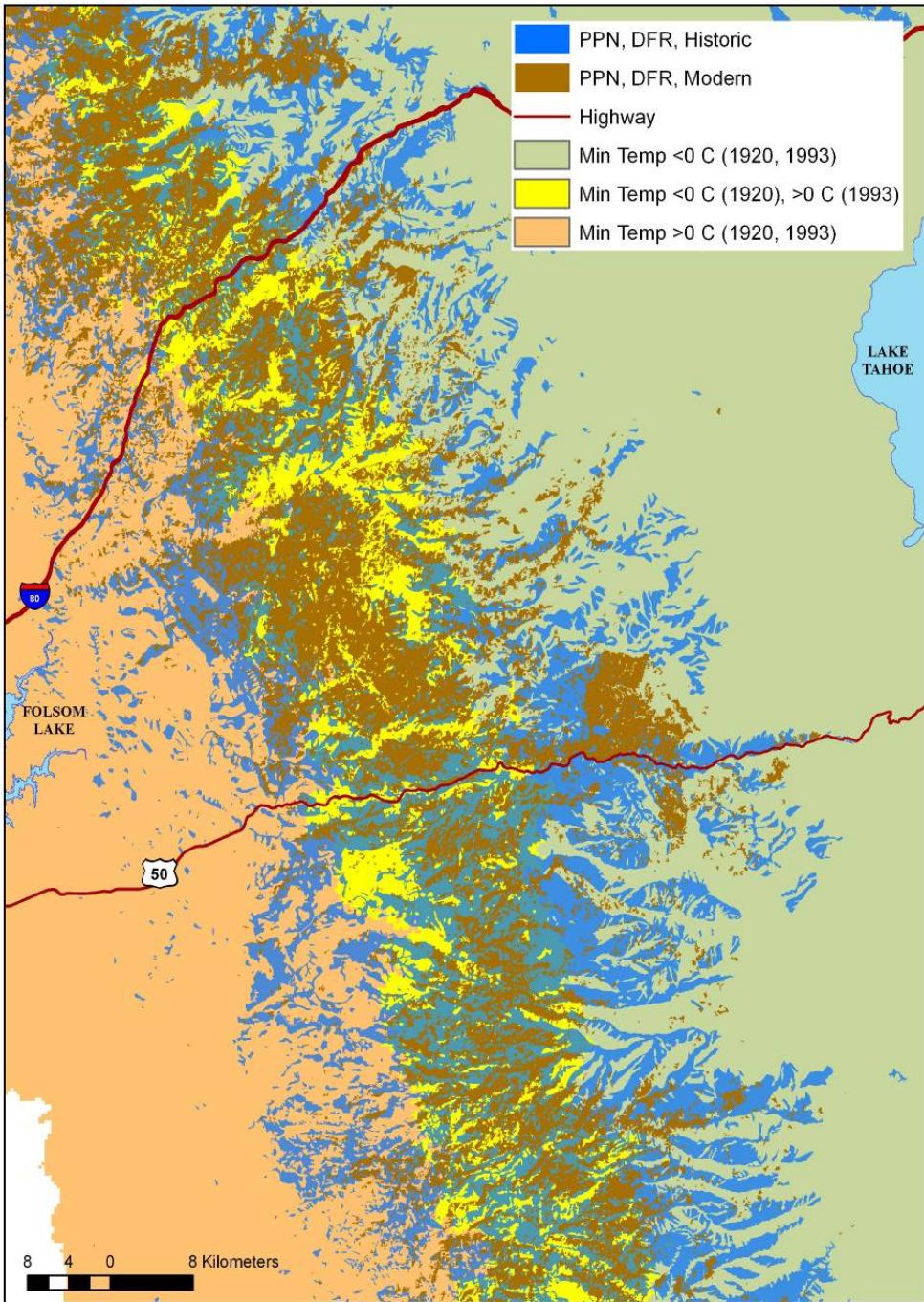
Winter Minimum Temperature Difference - Dec, Jan, Feb

Difference = Tmin 1993 - Tmin 1920*



*1920 data is the average between 1900-1940; 1993 data is the average between 1980-2006

Ponderosa Pine/Douglas Fir Transition



How is recruitment limited?

A. Increased drought kills germination outright.

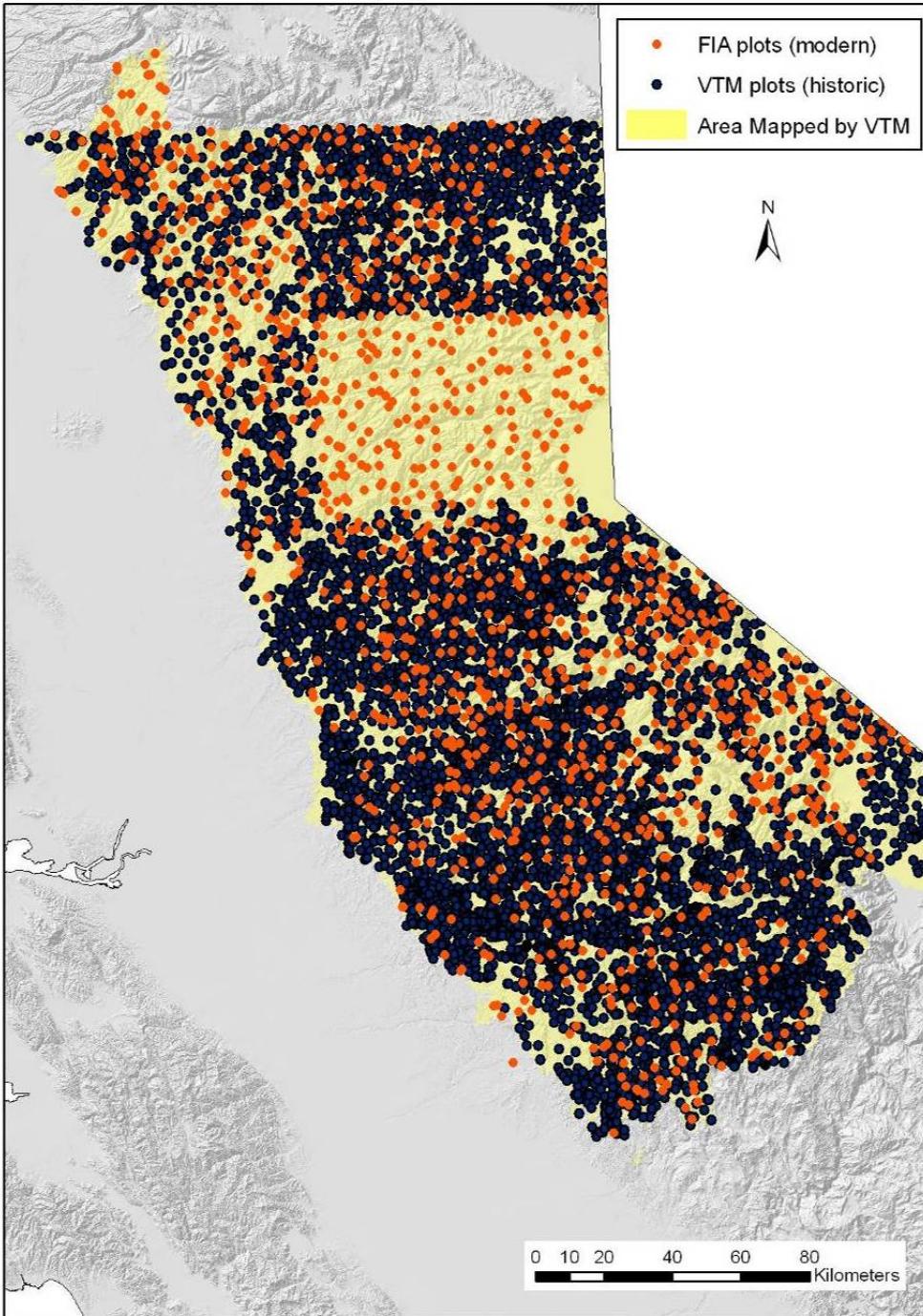
Evidence: lower limit studies on Ponderosa in Arizona & mortality studies using seedlings (Barton 1993)

B. Competitive Interactions

Evidence: Ponderosa tend to slow respiration when drought stressed

(to 12% of total rate at -10 bars soil moisture
Lopushinsky & Klock 1974)

plants it competes with at lower elevations do not (e.g. Greenleaf manzanita
Shainsky & Radosevich 1986)

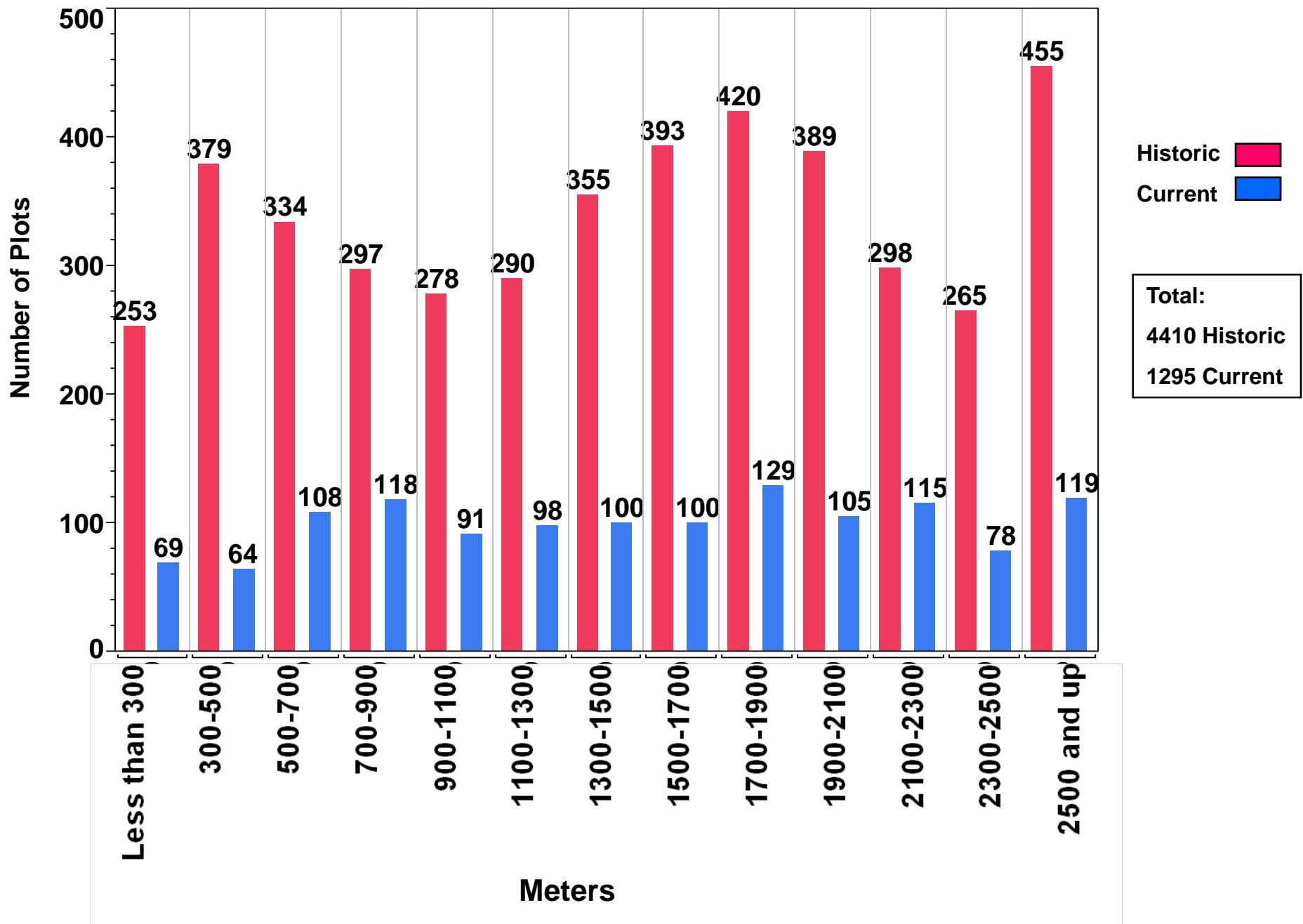


Total:
4410 Historic
1295 Current

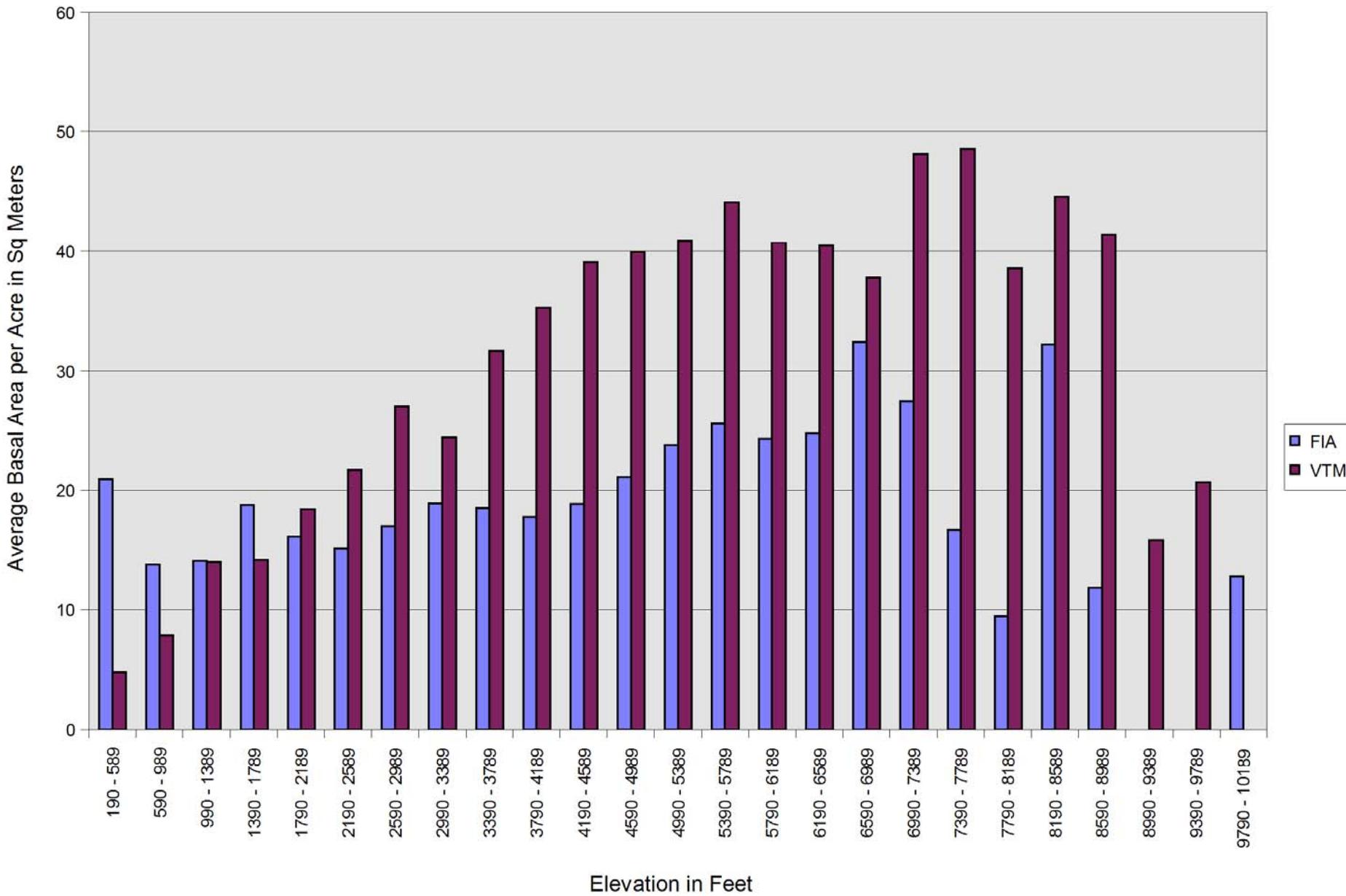
Combining plot data to the analysis offers the chance to examine changes in forest structure over time.

Better integration of the climate data into analyses is also needed.

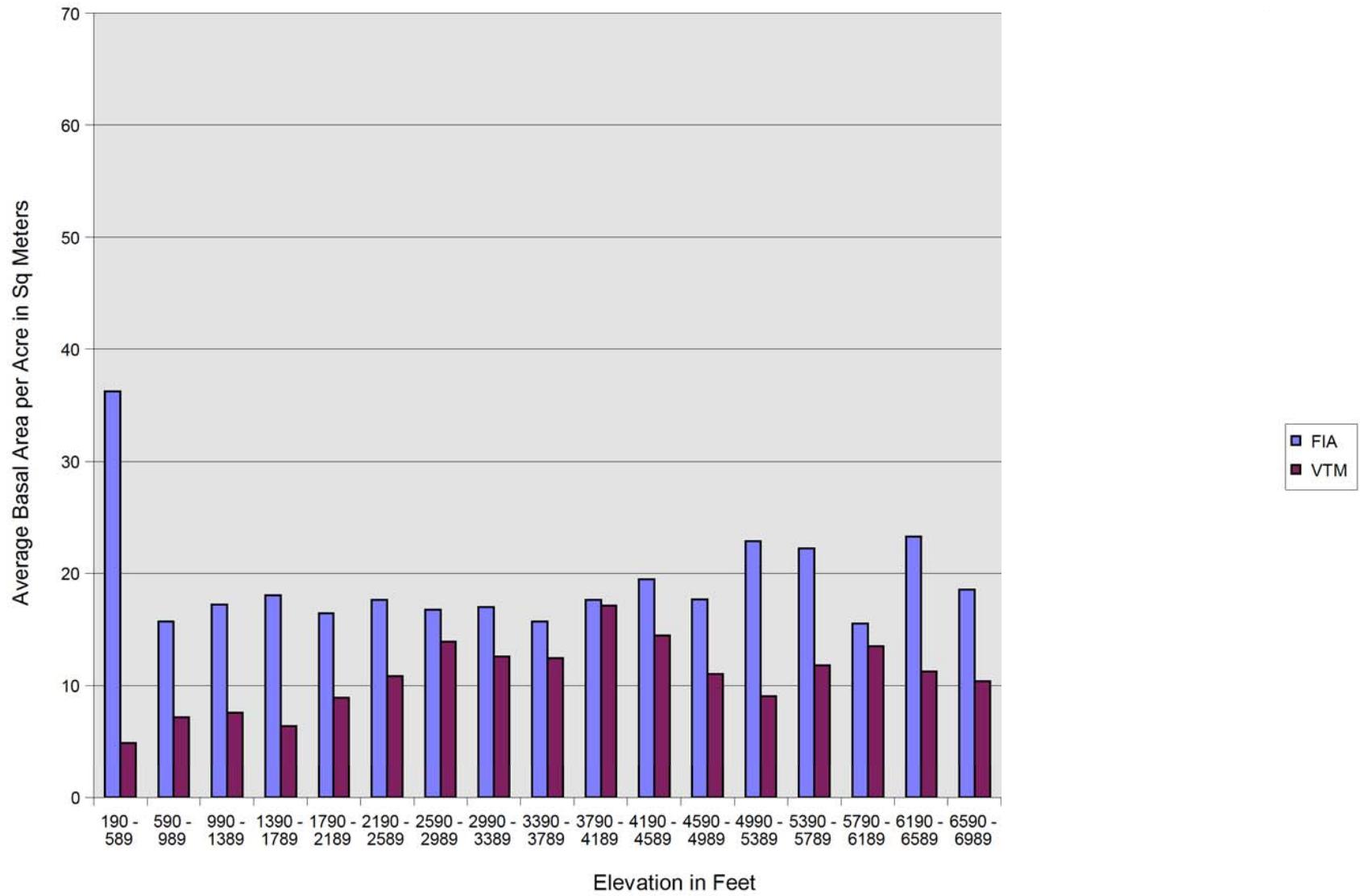
Number of Plots by Elevation



Conifers: Pipo, Psme, Pila, Cade, Abco

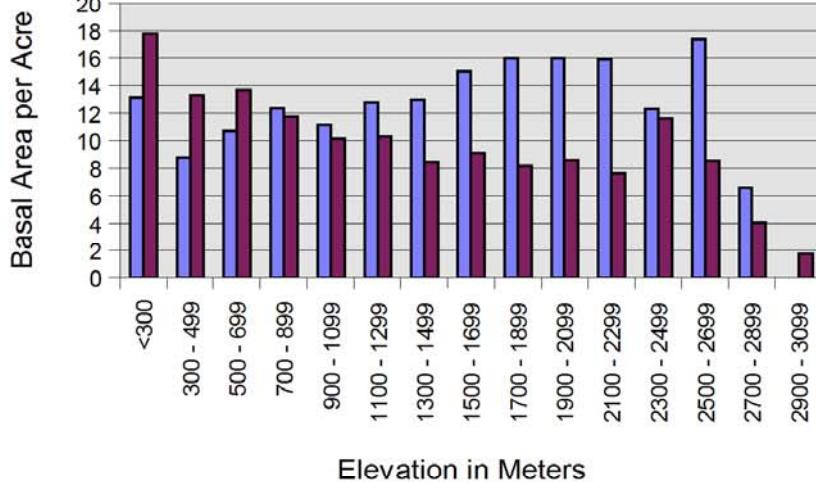


Hardwoods: Quke, Quwi, Quch, Arme, Lide

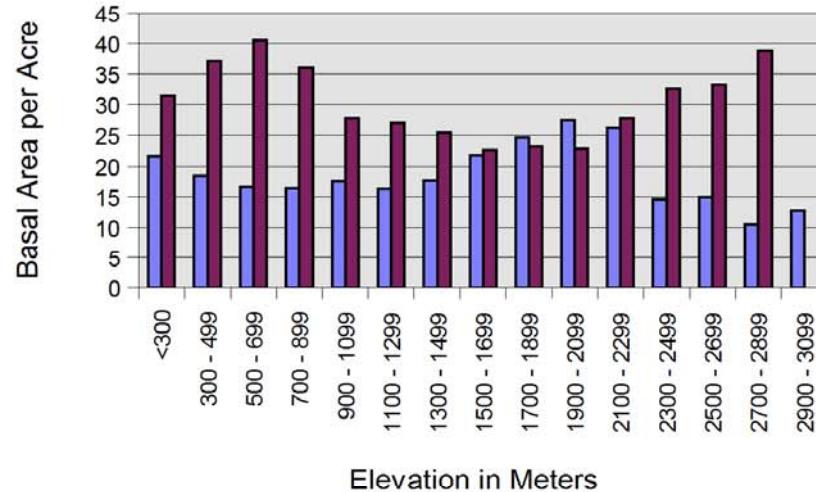


Conifers: Pipo, Psme, Pila, Cade, Abco

04_119

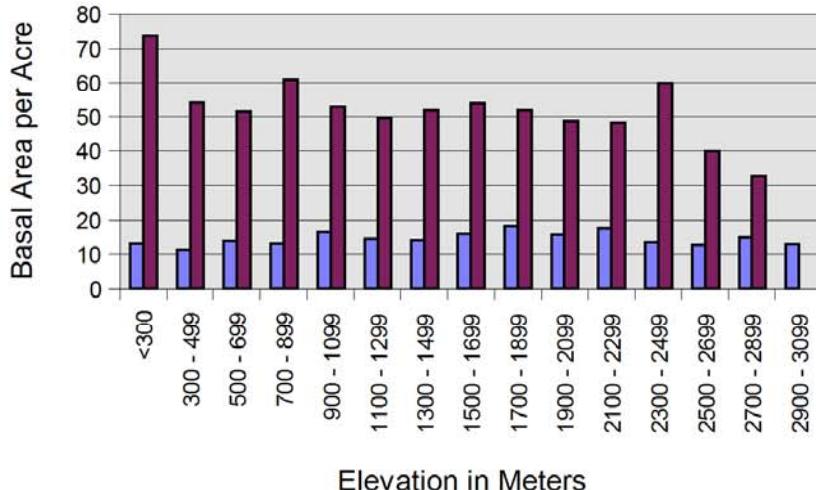


12_239

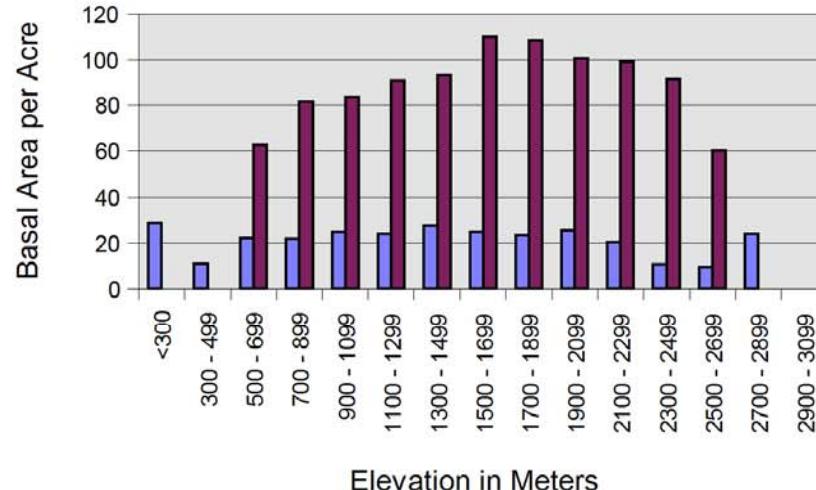


█ FIA
█ VTM

24_359

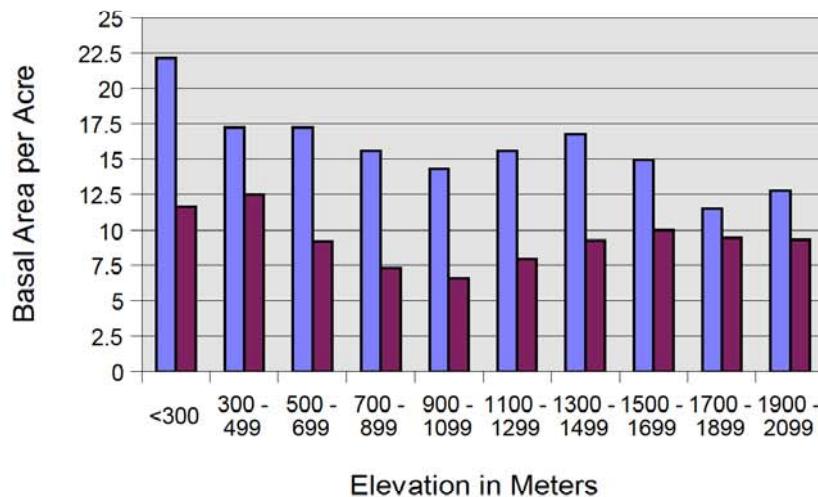


36_up

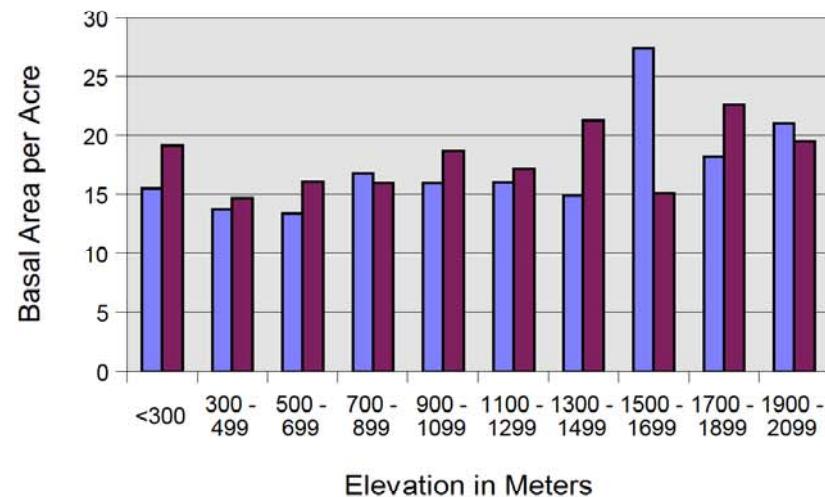


Hardwoods: Quke, Quwi, Quch, Arme, Lide

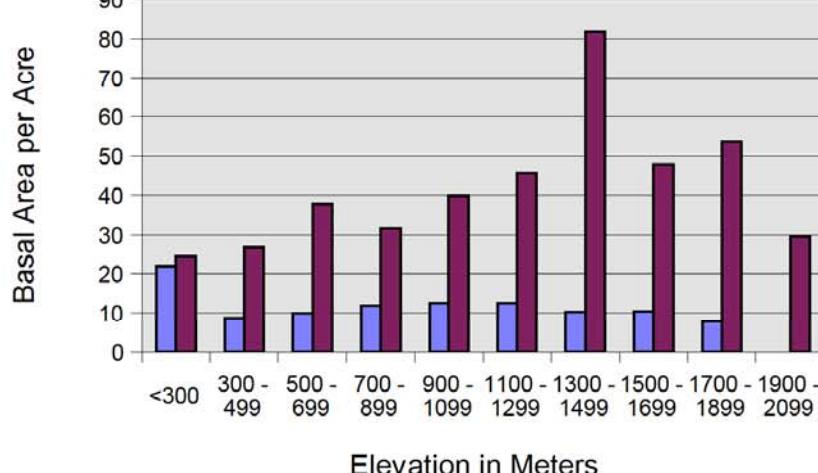
04_119



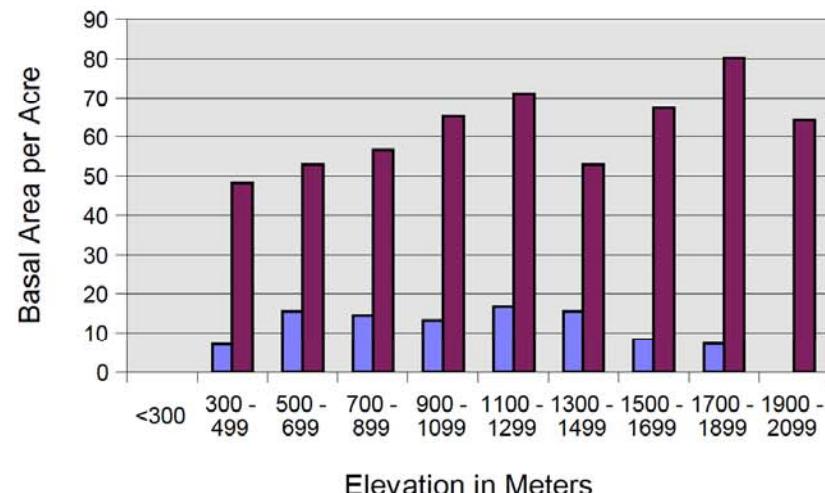
12_239



24_359

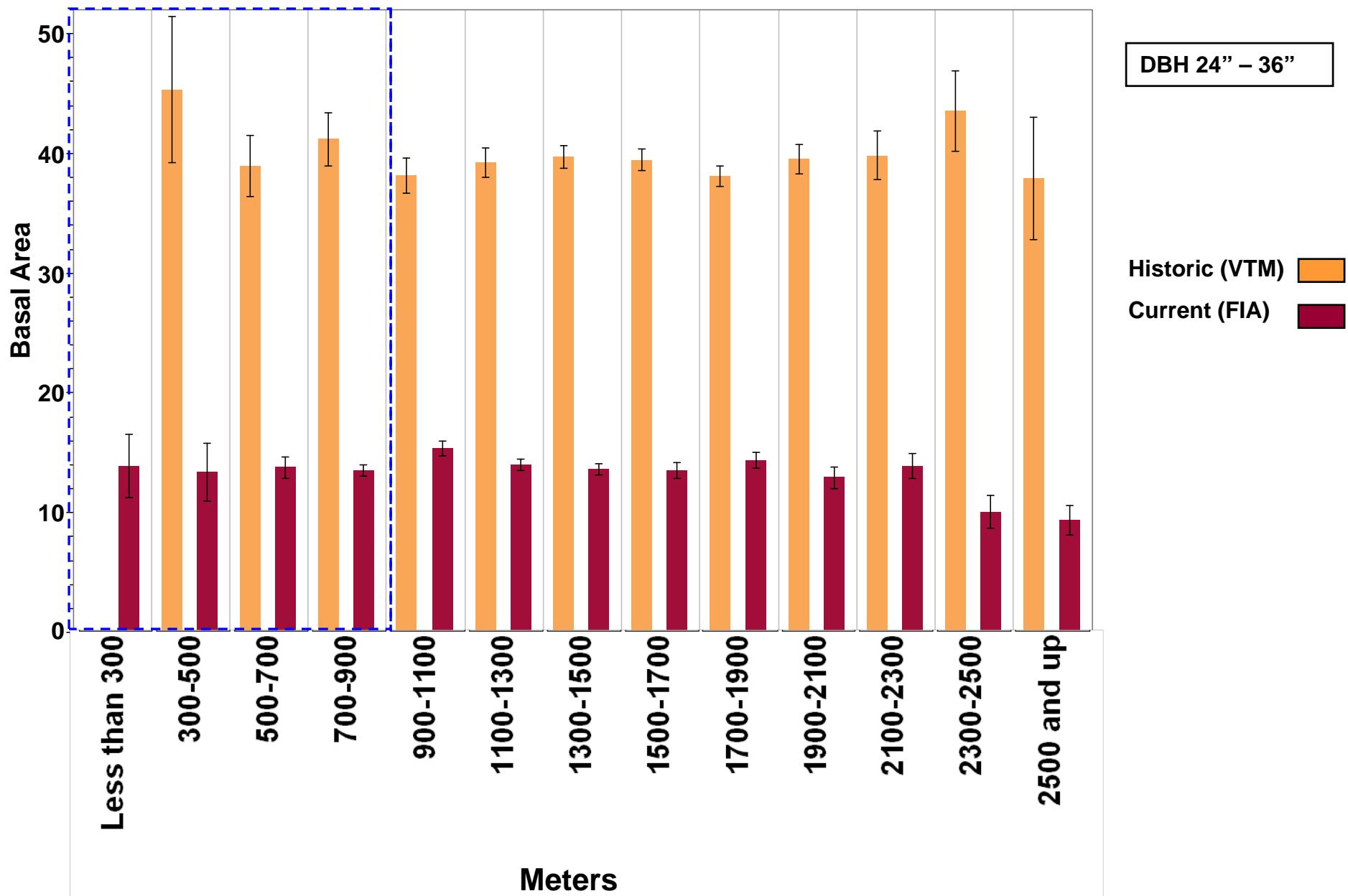


36_up

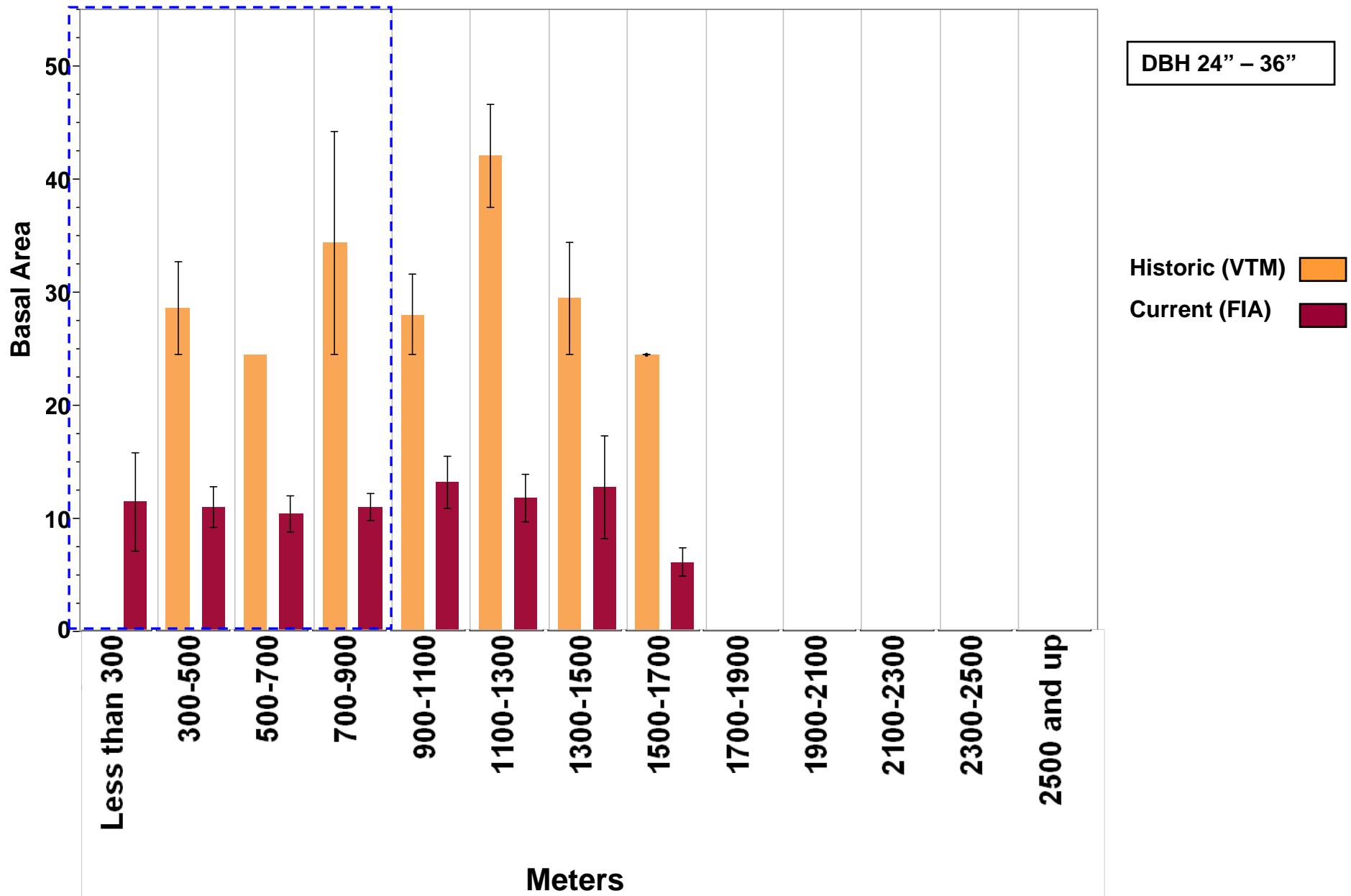


█ FIA
█ VTM

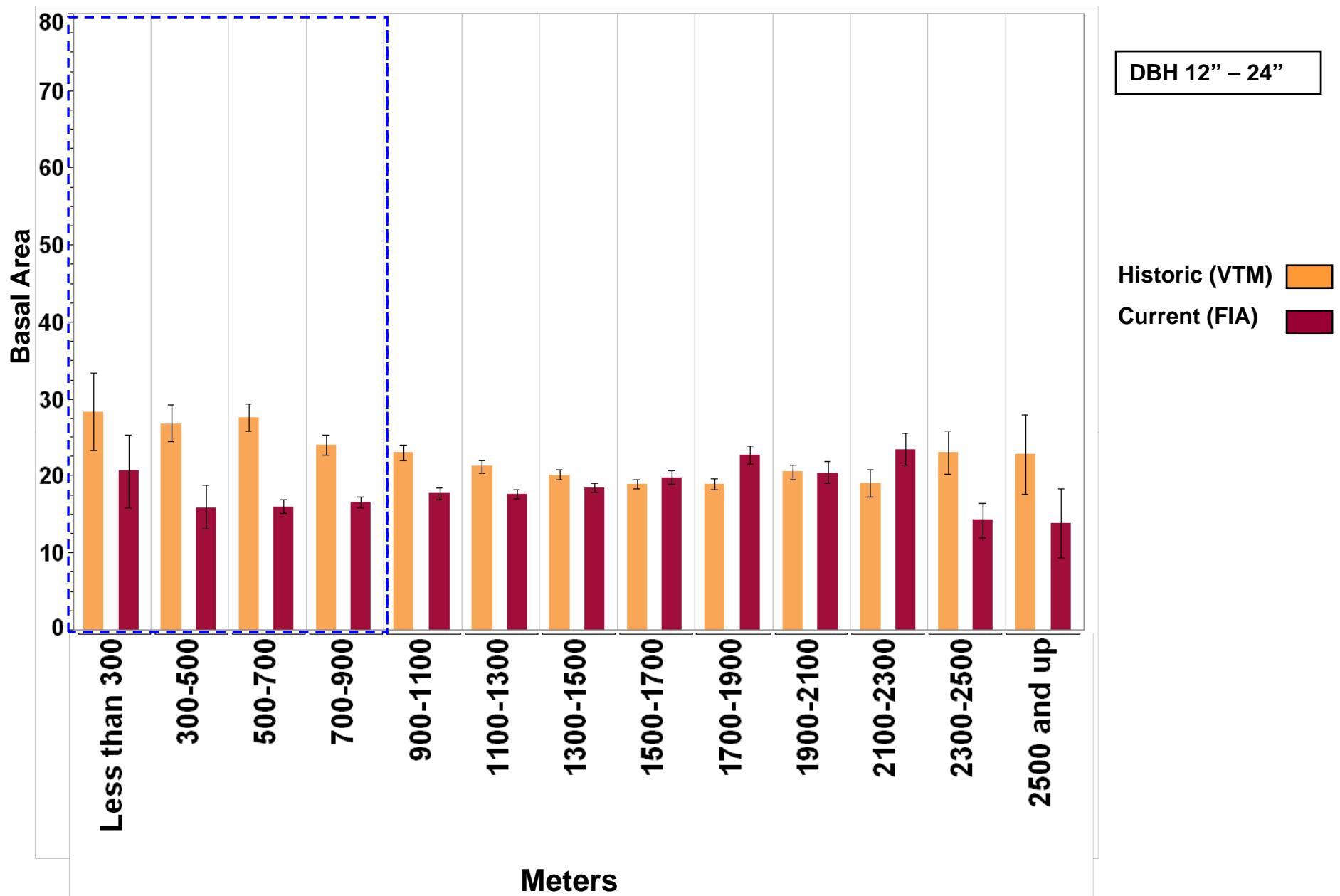
Conifers



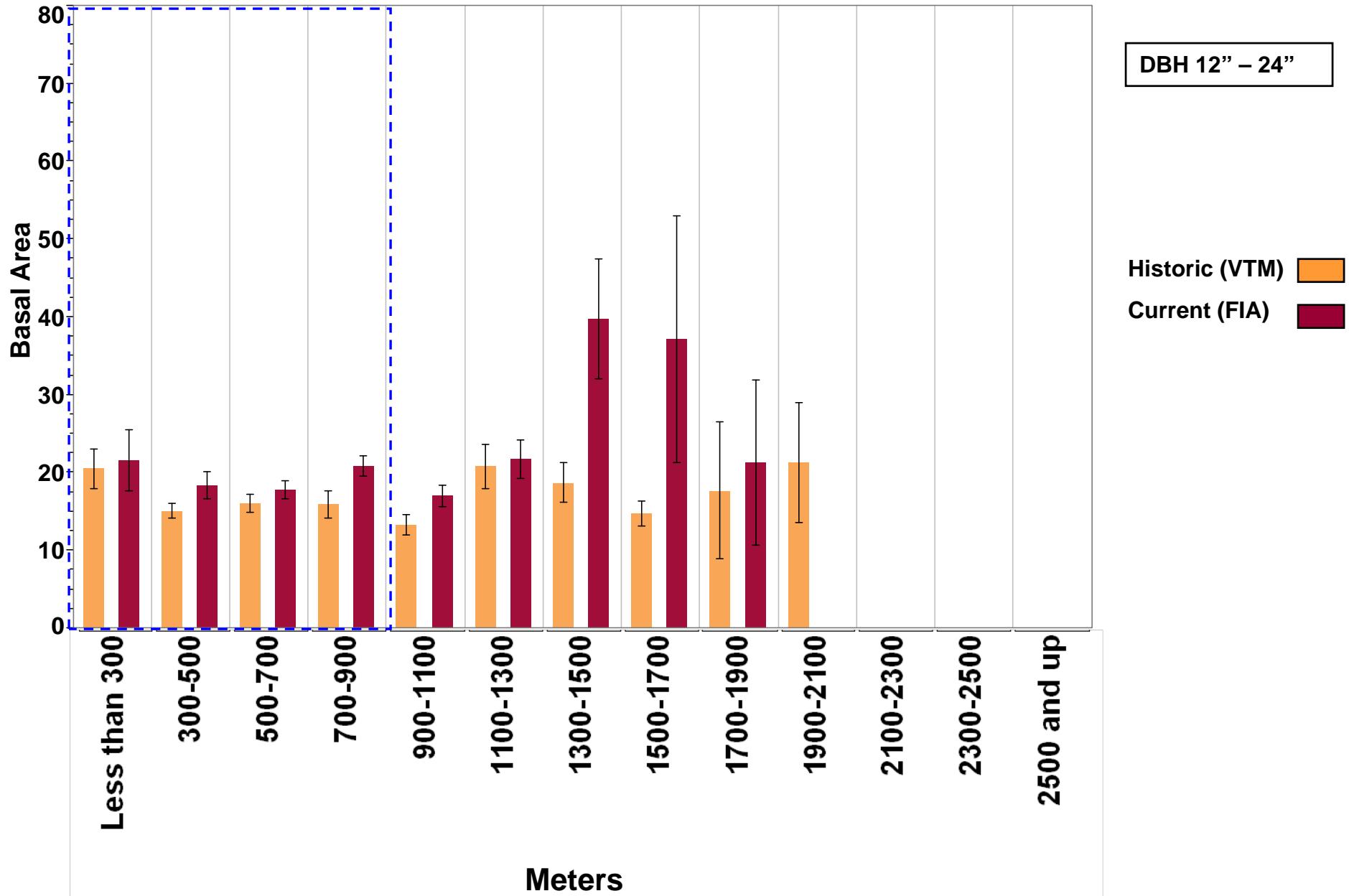
Hardwoods



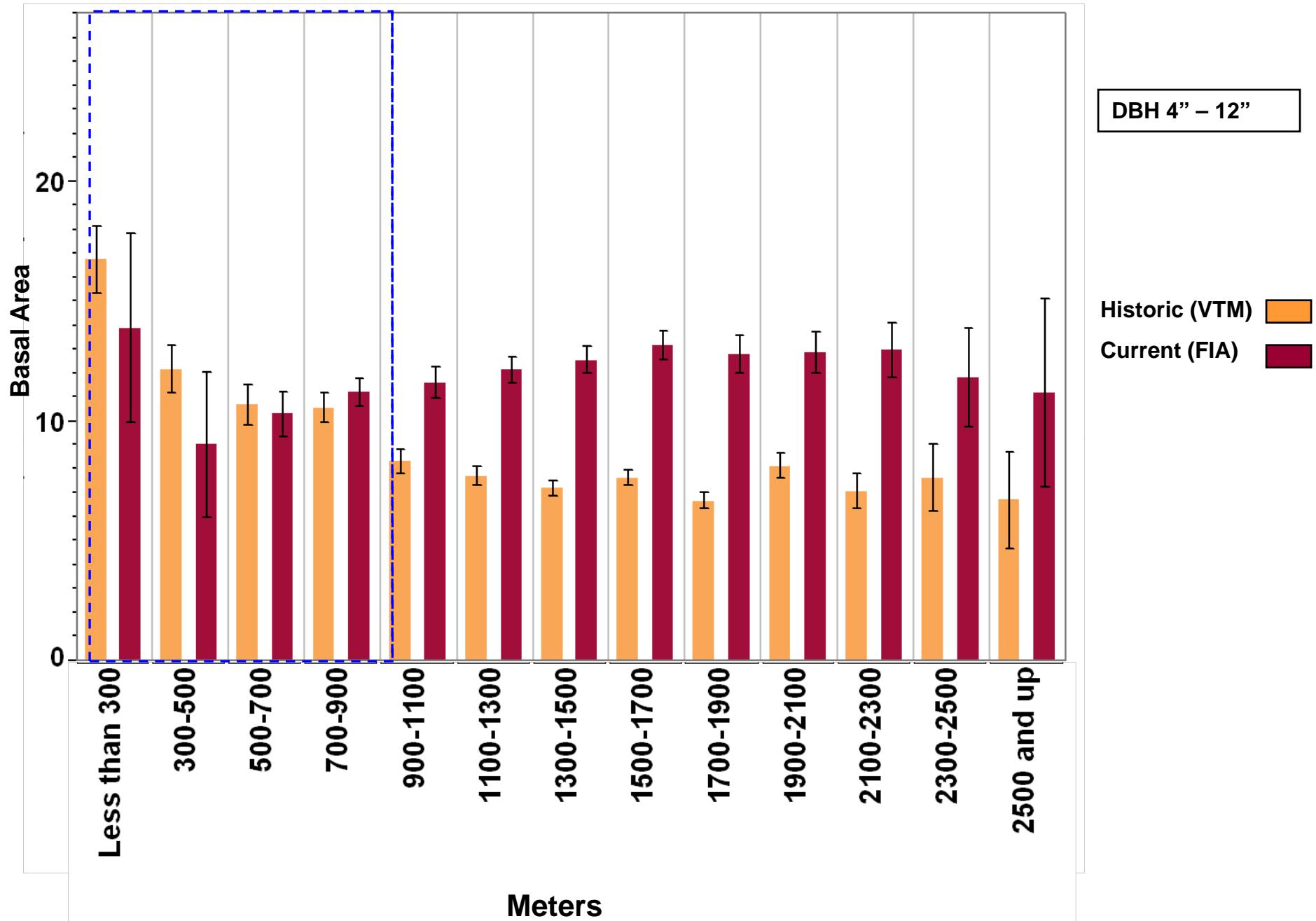
Conifers



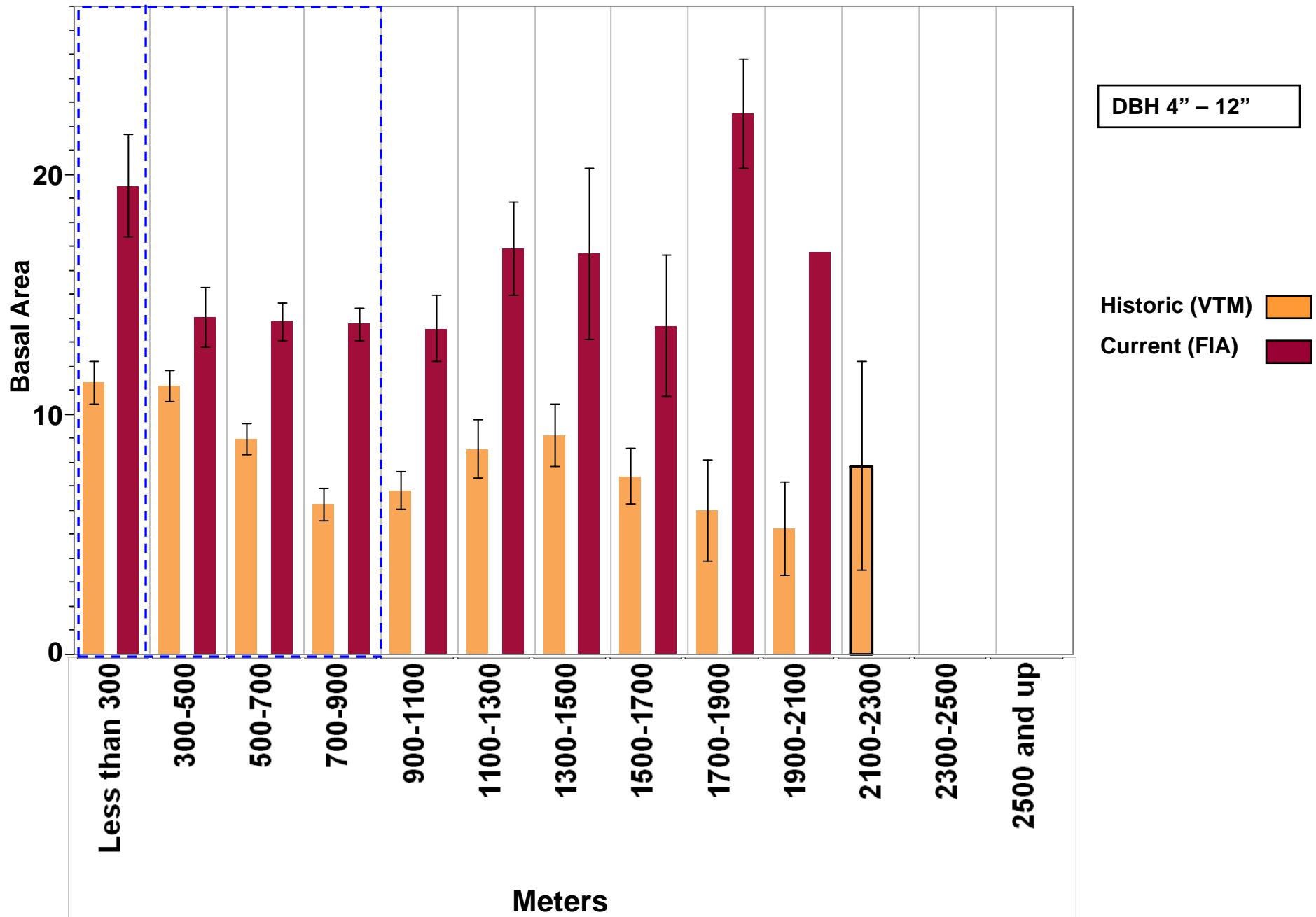
Hardwoods



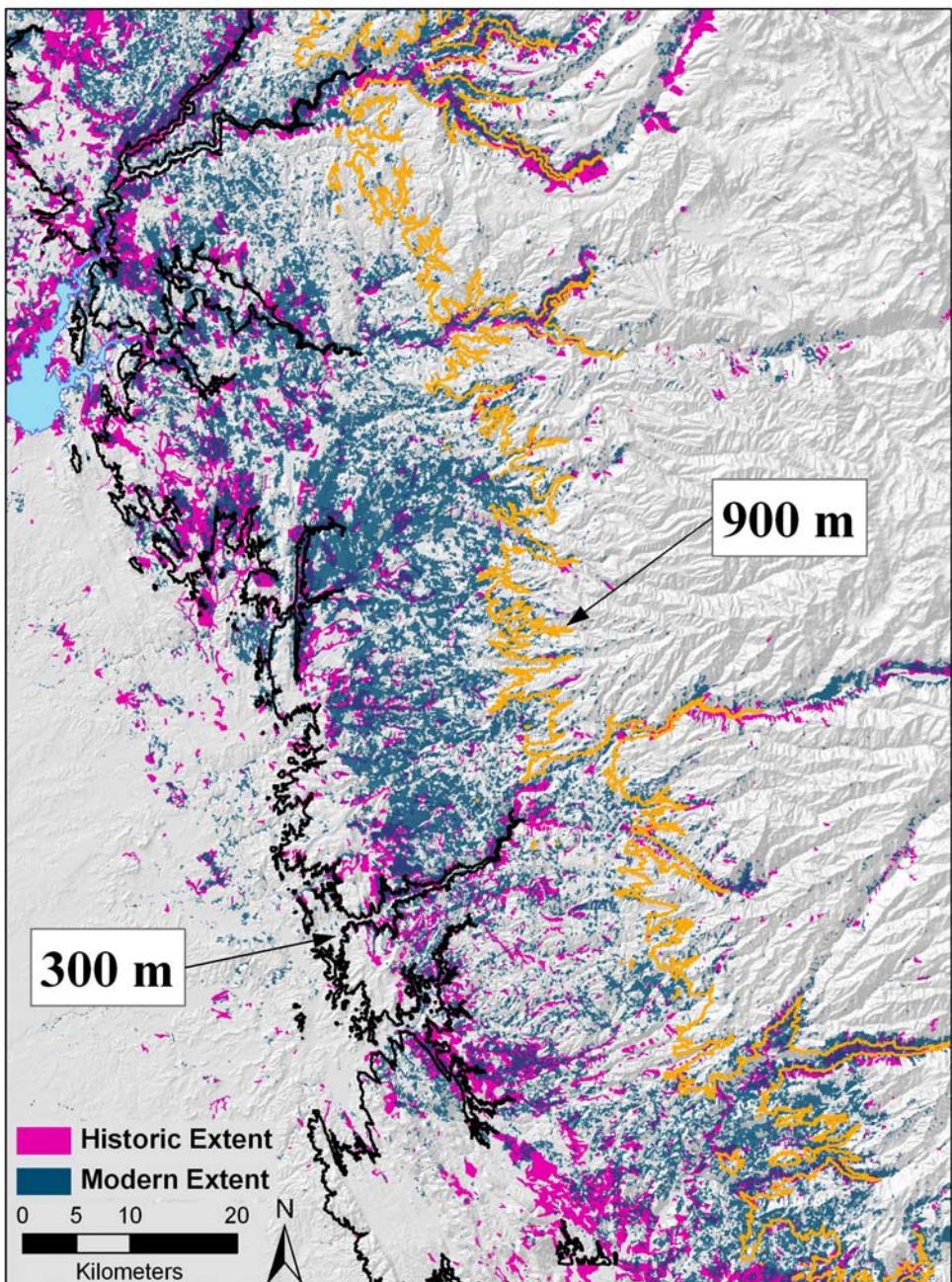
Conifers



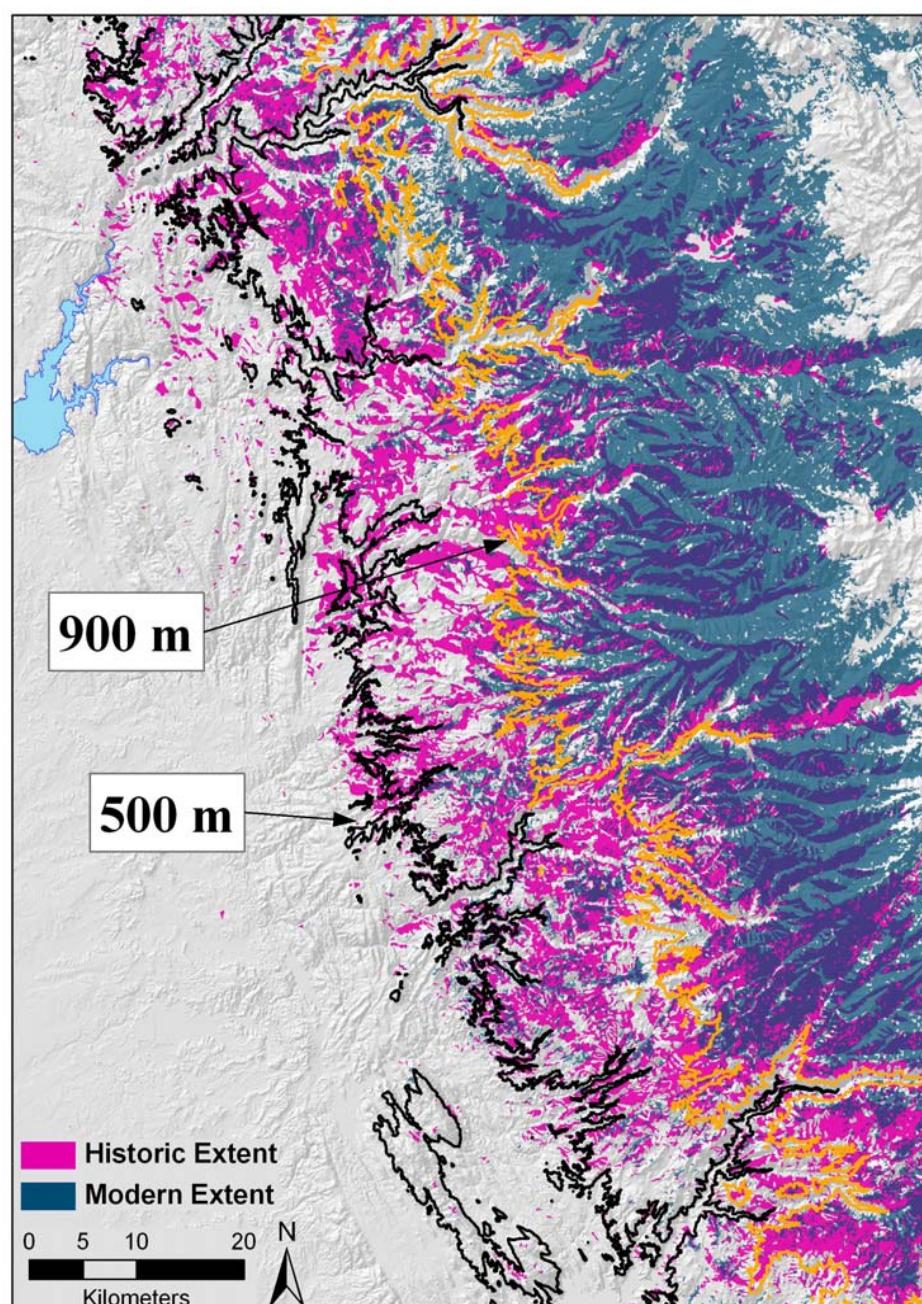
Hardwoods



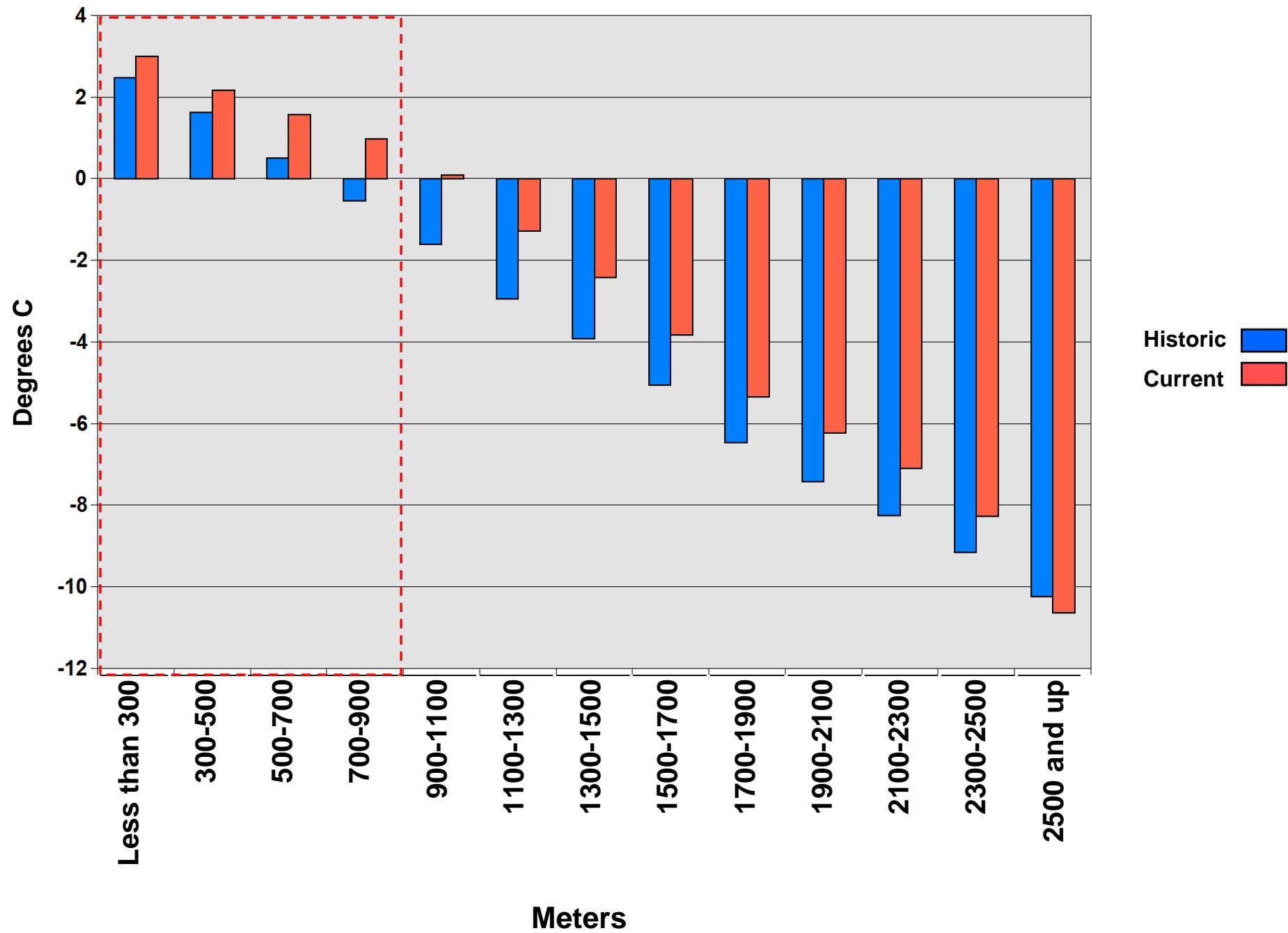
Montane Hardwood Transition



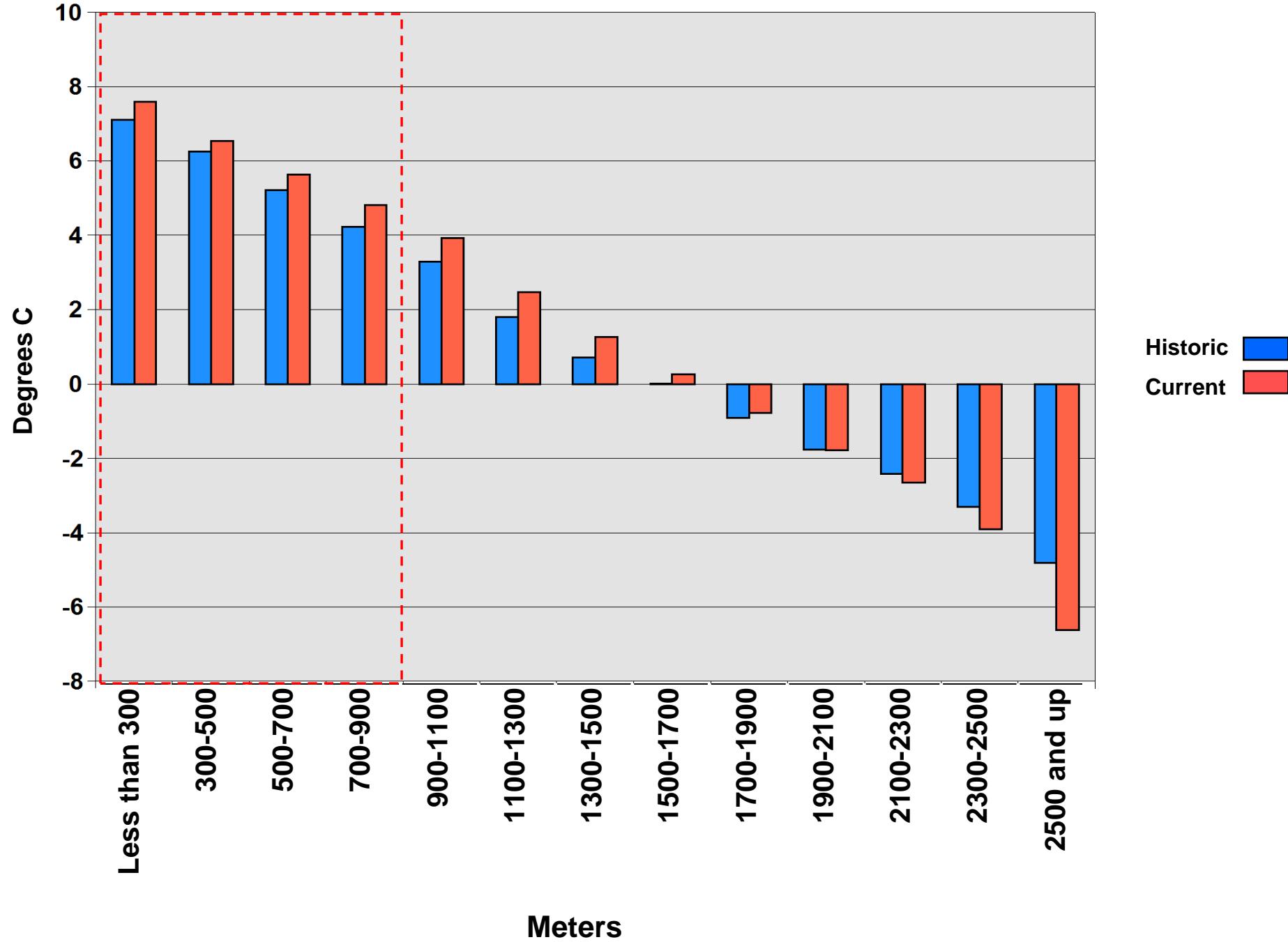
Ponderosa Pine Lower Transition



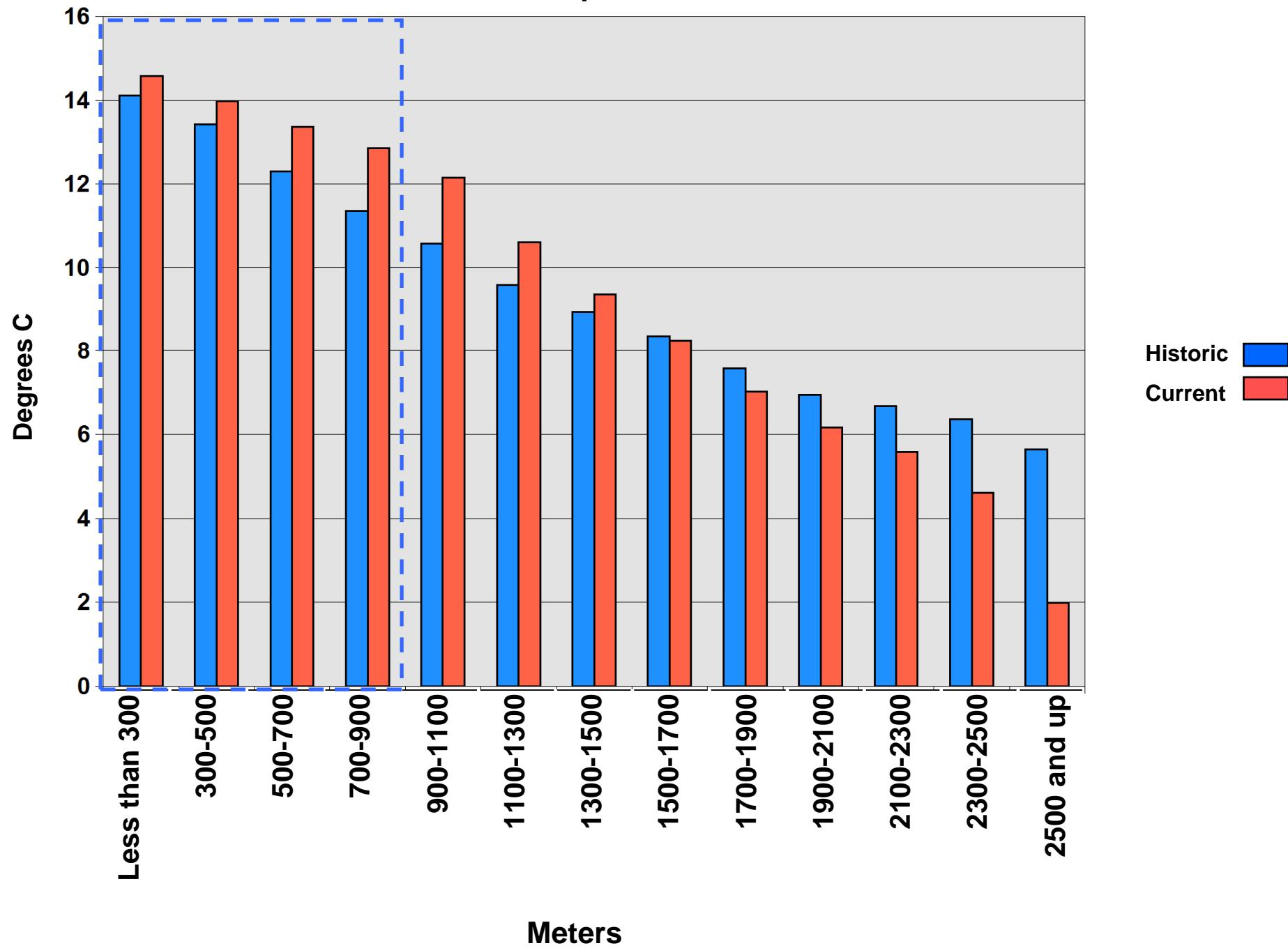
Minimum Temp – Quarter 1



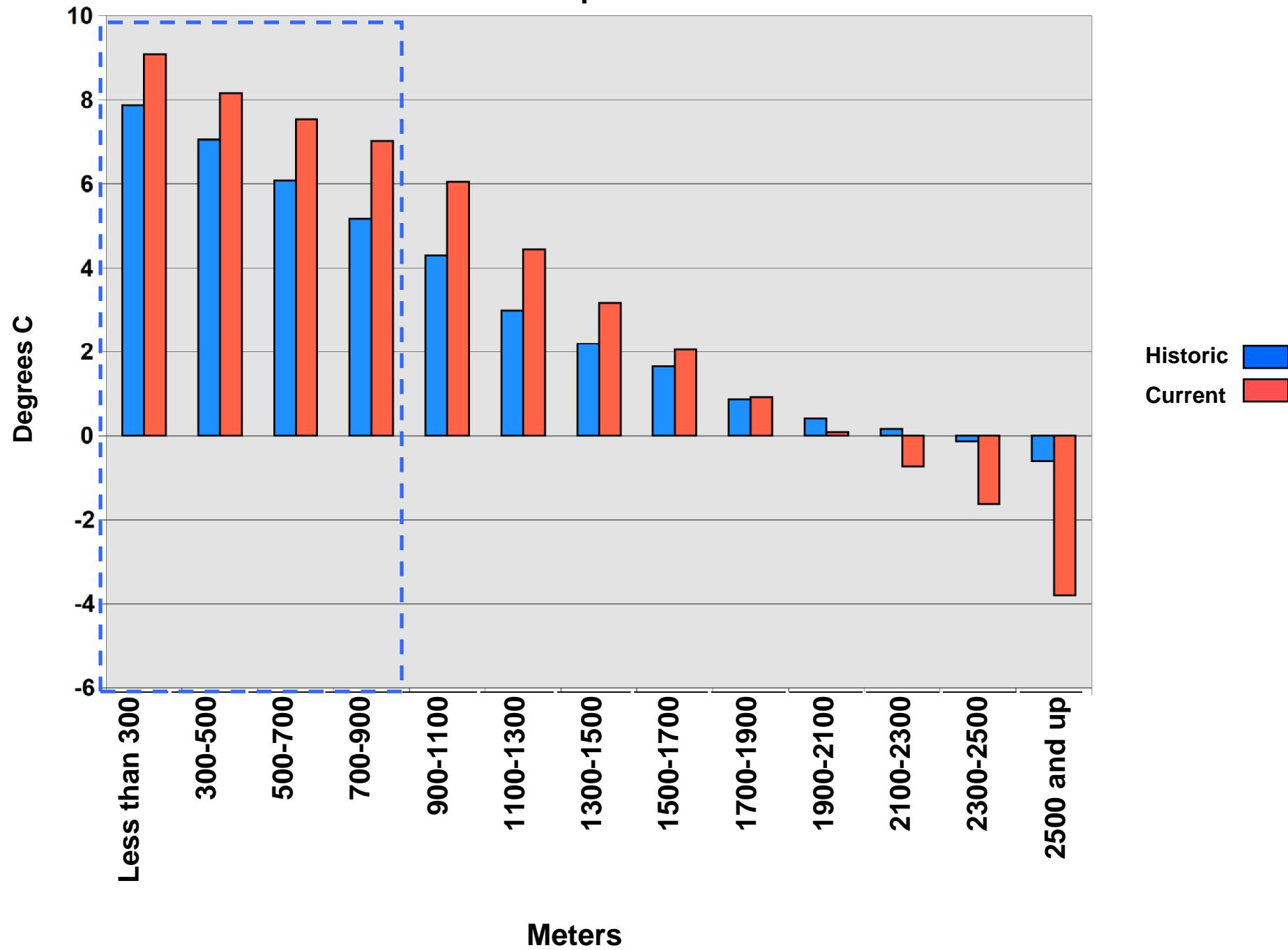
Minimum Temp – Quarter 2



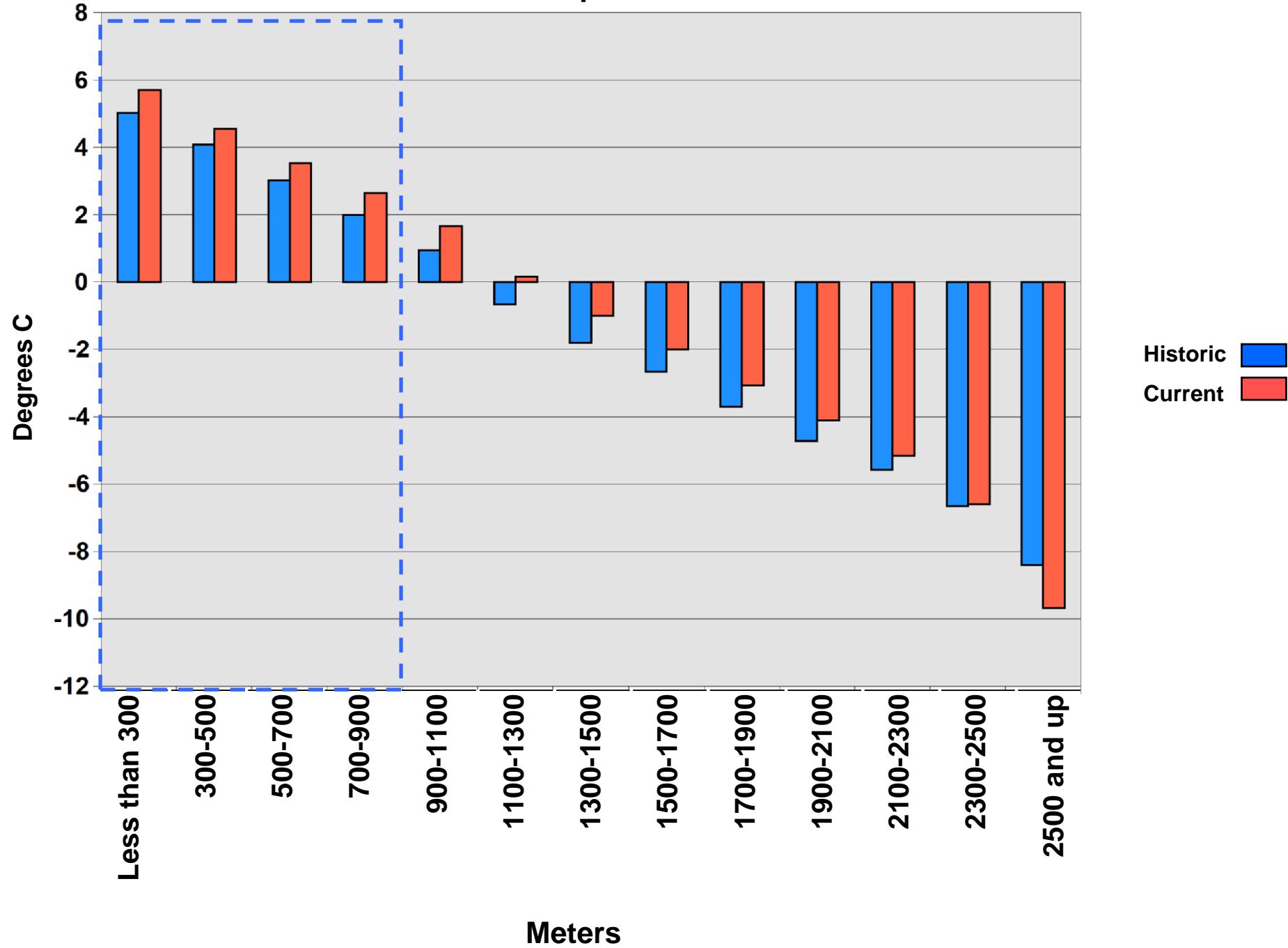
Minimum Temp – Quarter 3



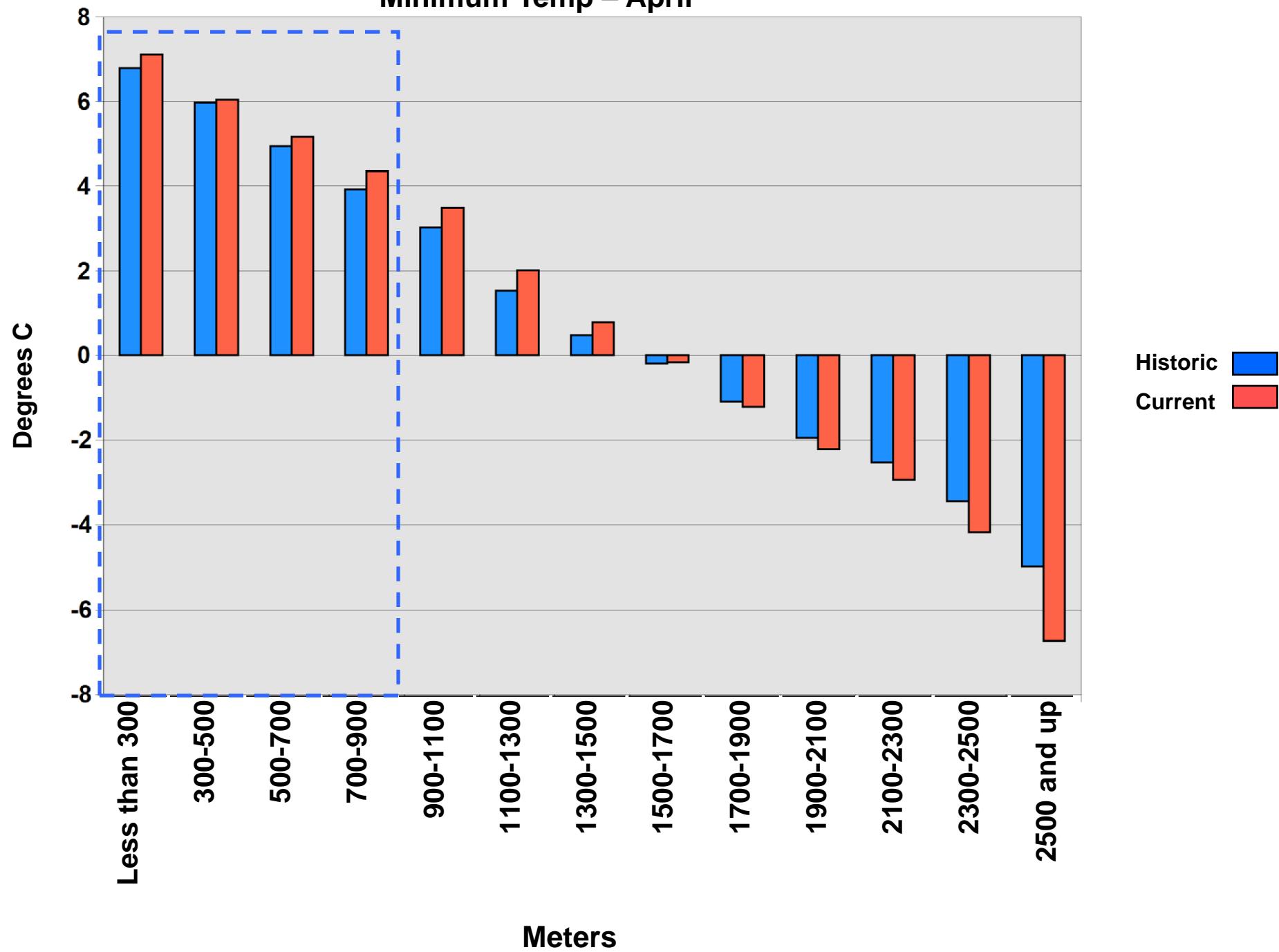
Minimum Temp – Quarter 4



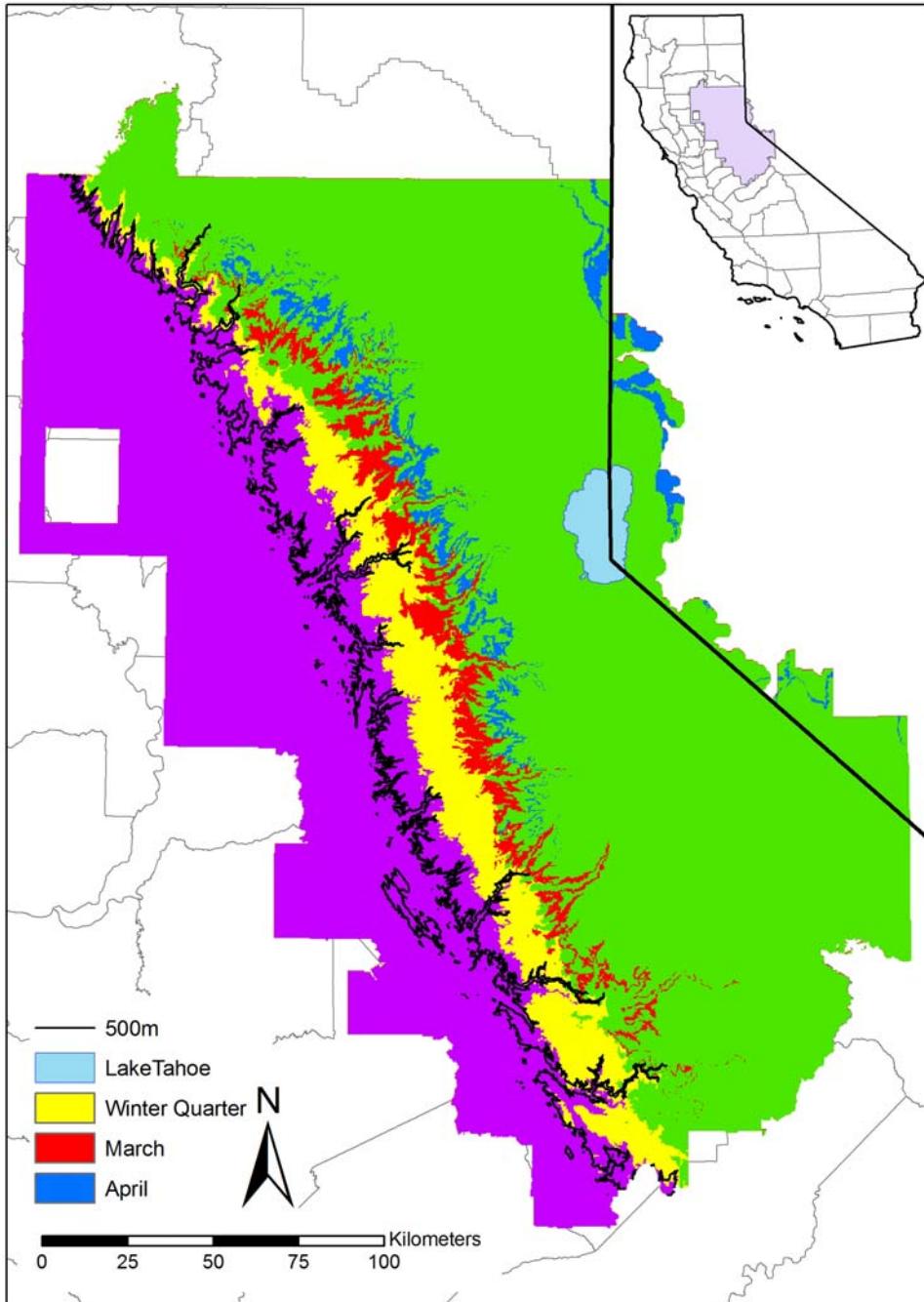
Minimum Temp – March



Minimum Temp – April



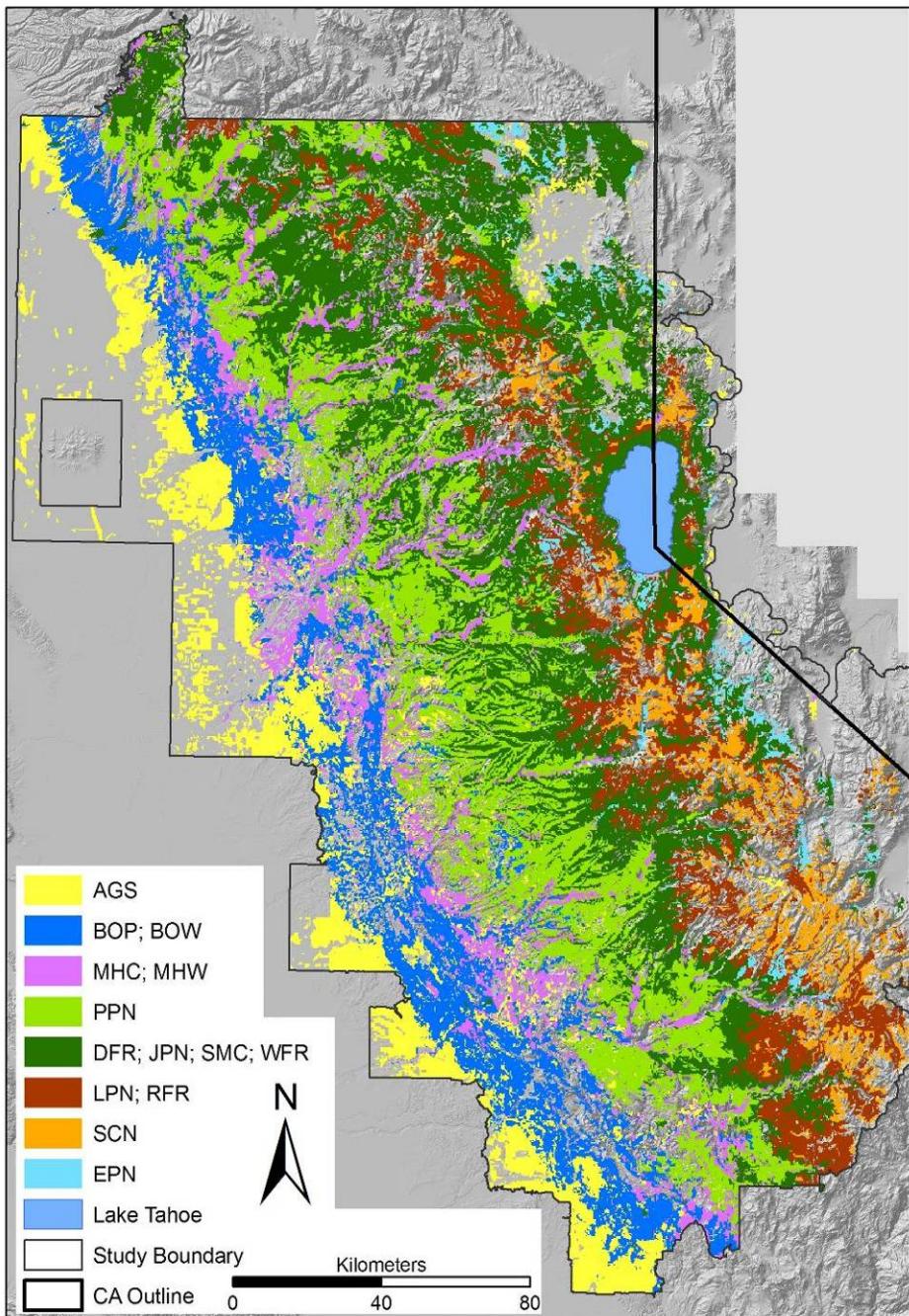
Freezeline Retraction in March and April



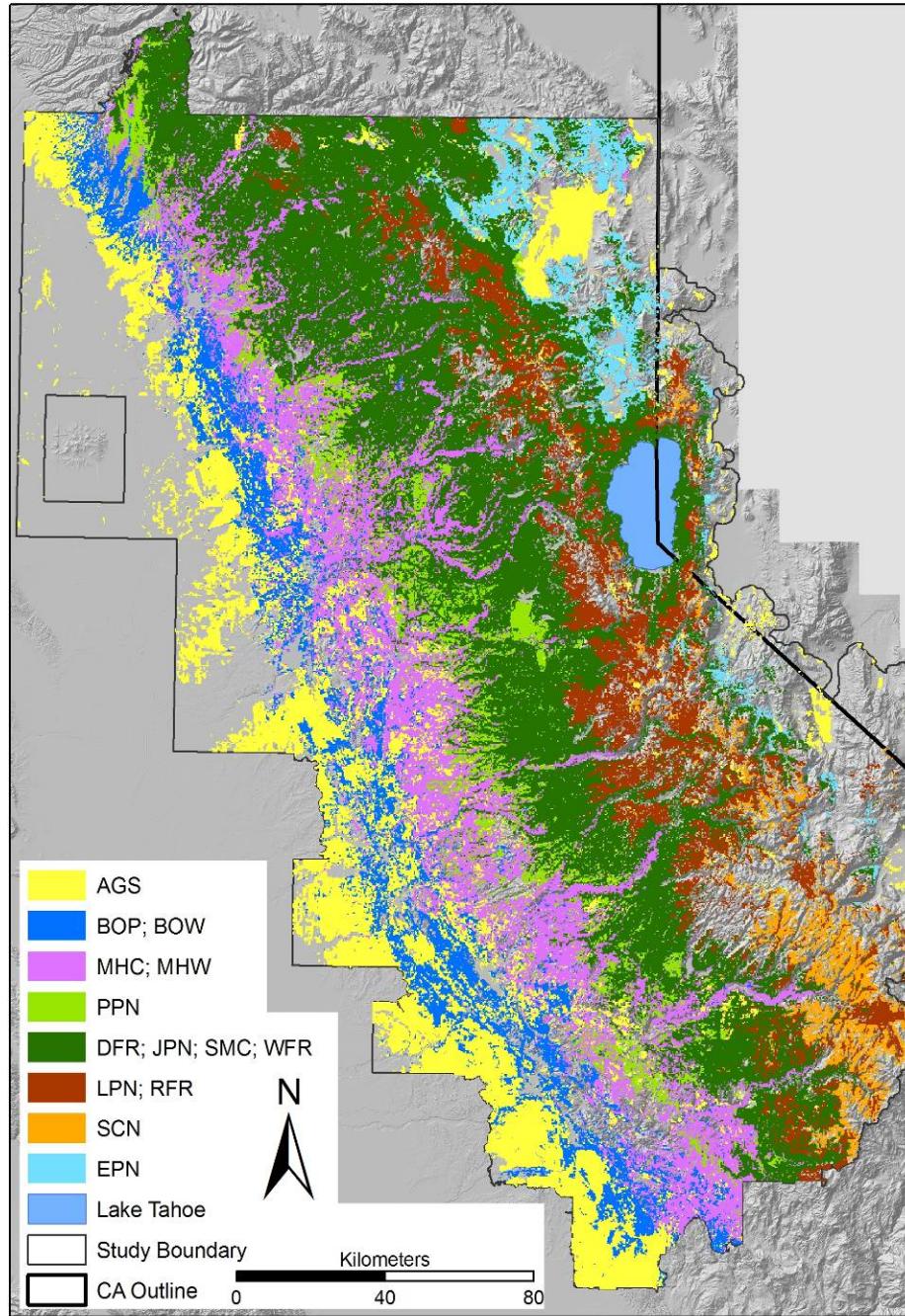
Different thresholds

Different Biotic Response?
Landcover change
Phenology

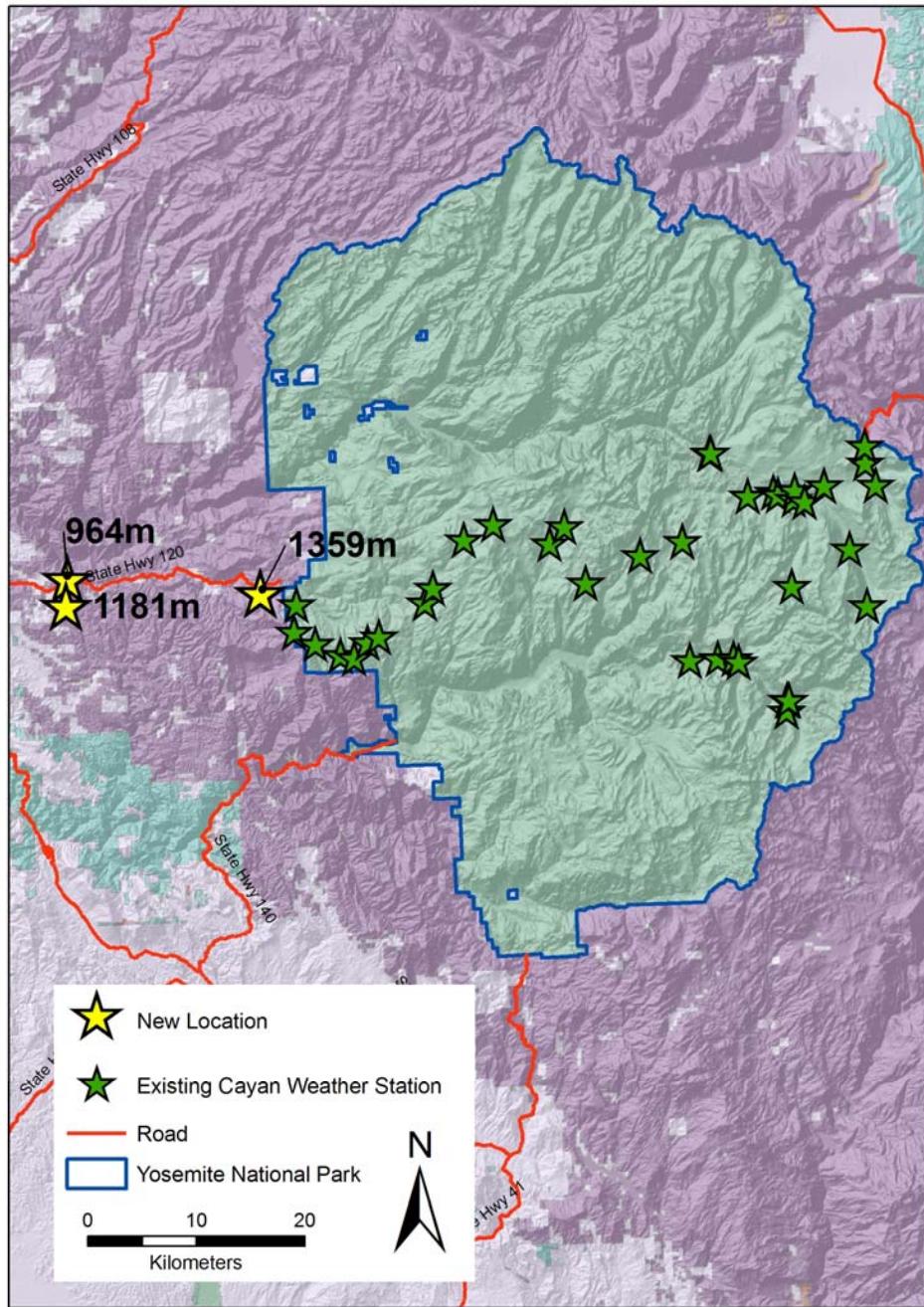
Historic WHR Types



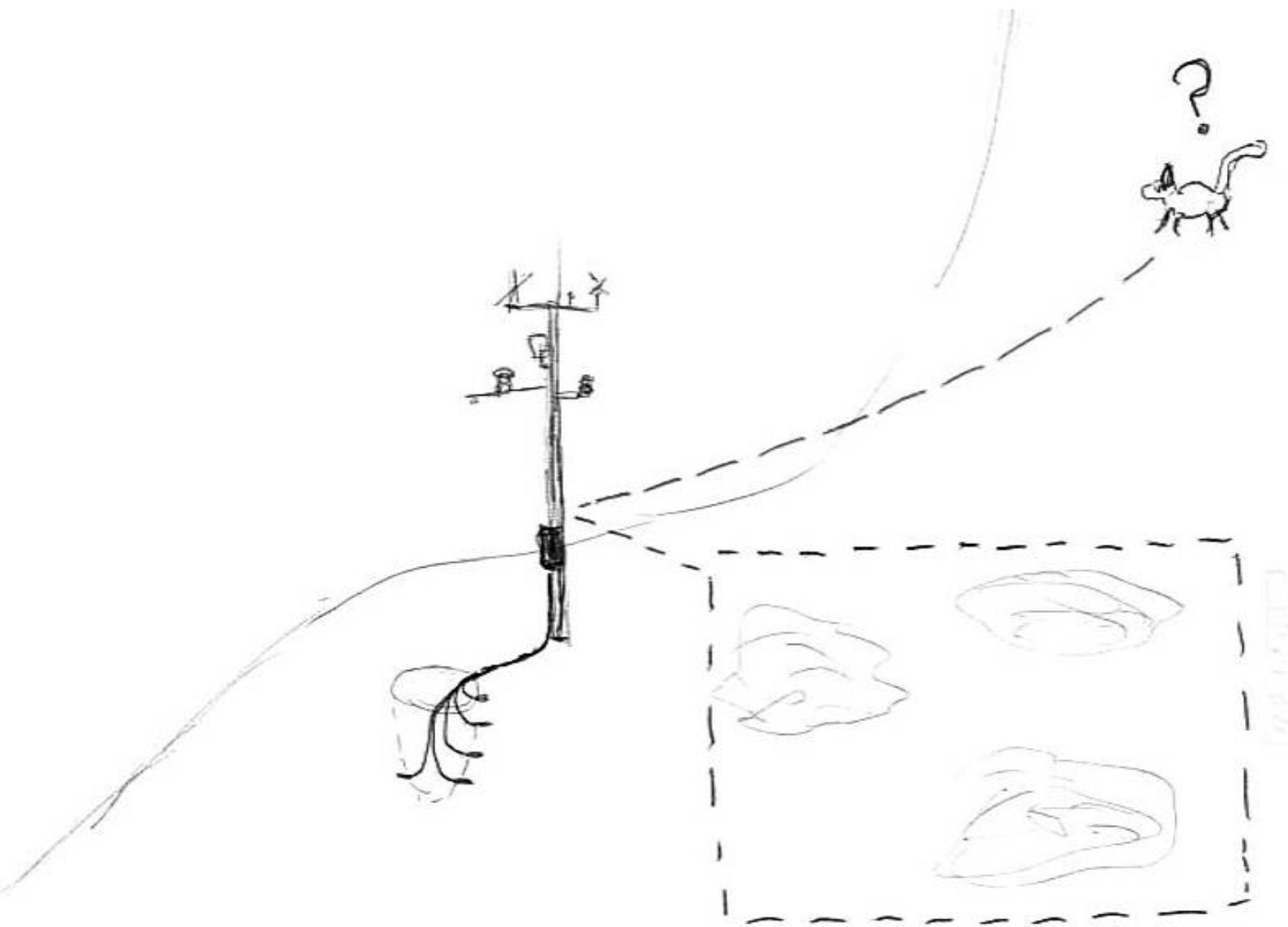
Current WHR Types



The 3 Locations Identified as Possible Sites for New Weather Stations*

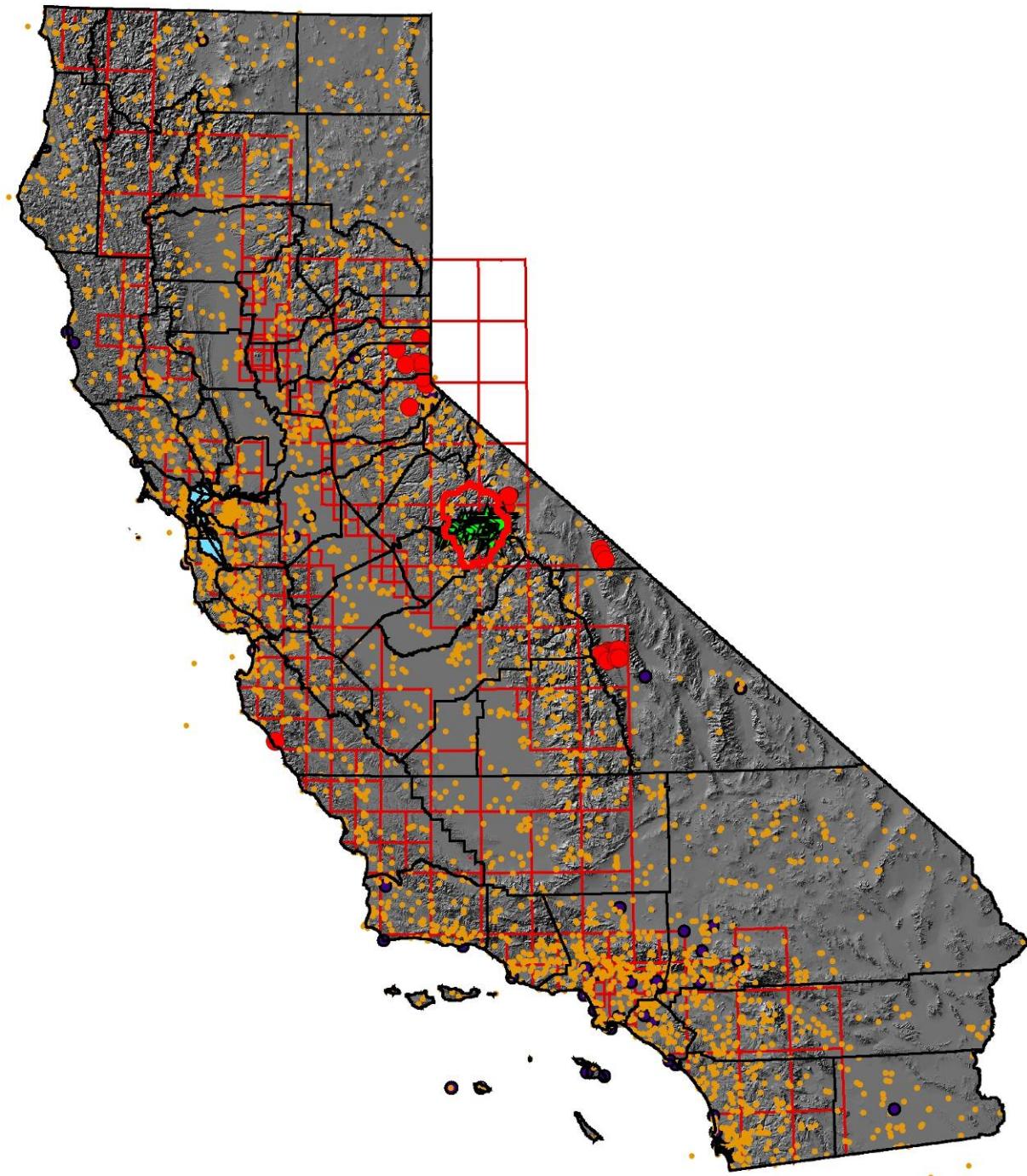


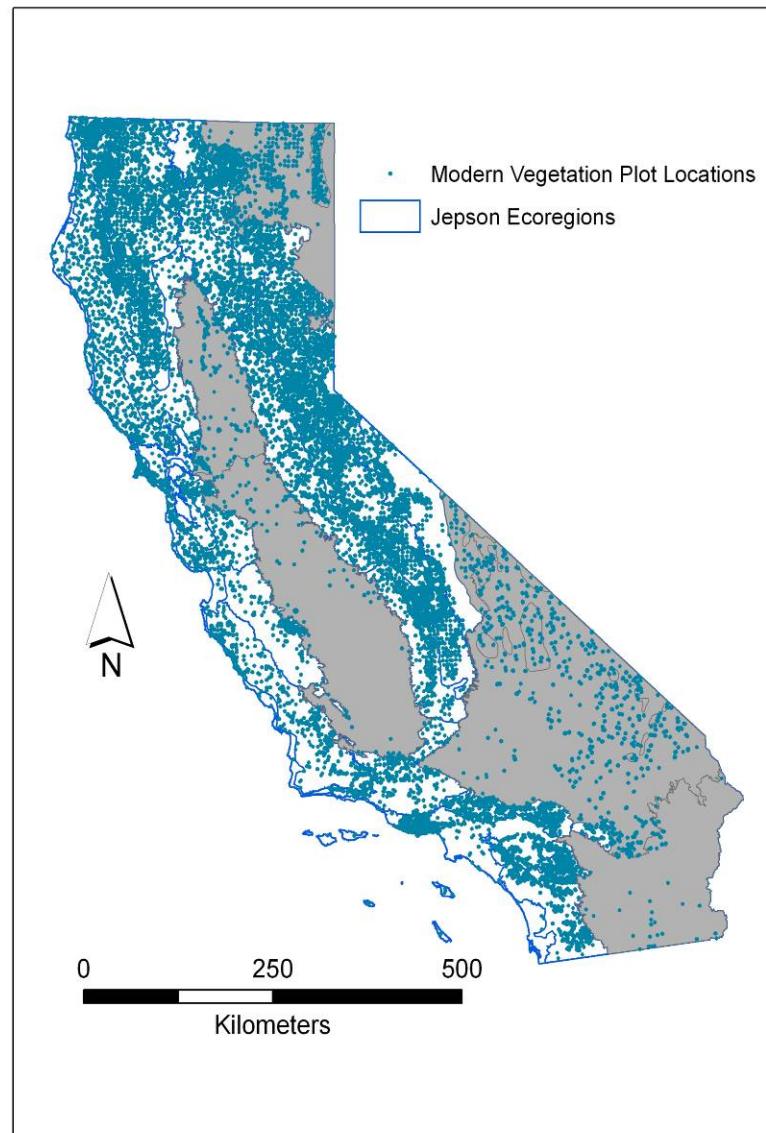
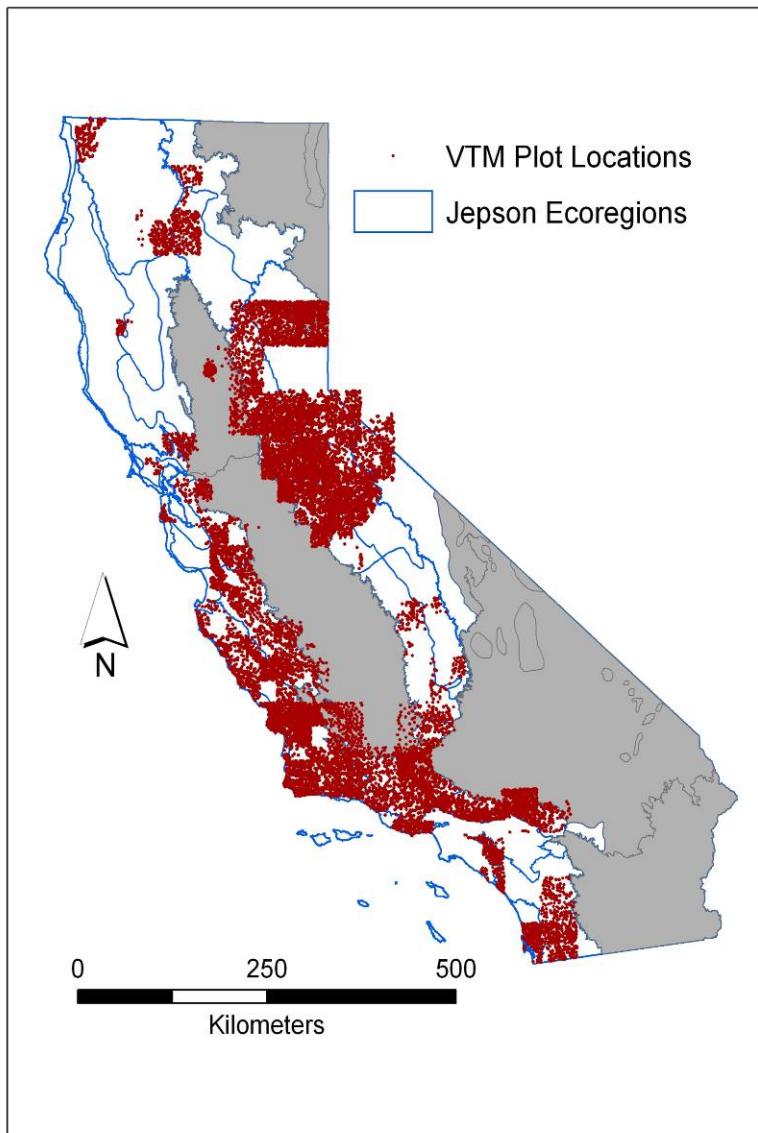
Extension of monitoring transects











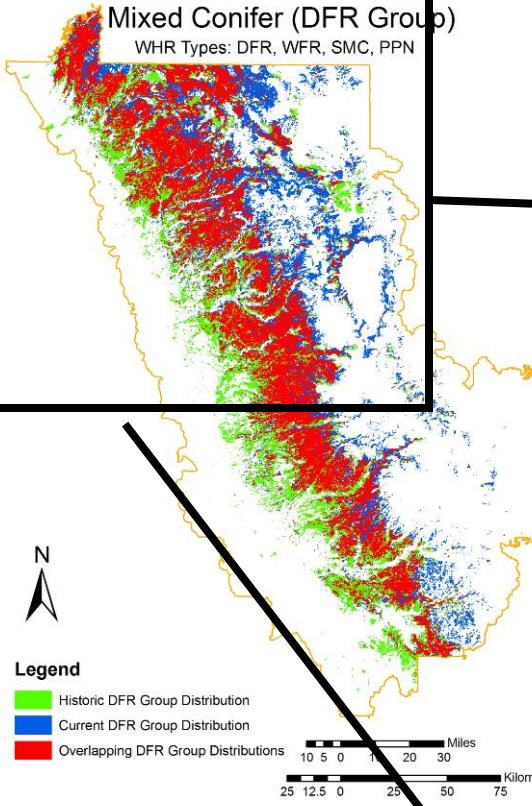


207860

**Thank you for your attention
jhthorne@ucdavis.edu**

Mixed Conifer (DFR Group)

WHR Types: DFR, WFR, SMC, PPN



Mixed Conifer (DFR Group)

WHR Types: DFR, WFR, SMC, PPN

Legend

